AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 15, NO. 46. WEEKLY. | NEW YORK, THURSDAY, NOVEMBER 17, 1892. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

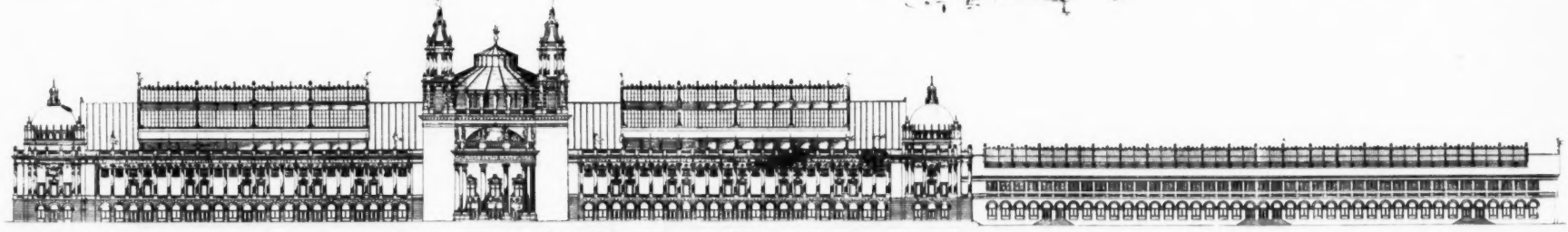
COPYRIGHT 1892, BY AMERICAN MACHINIST PUBLISHING COMPANY.

For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

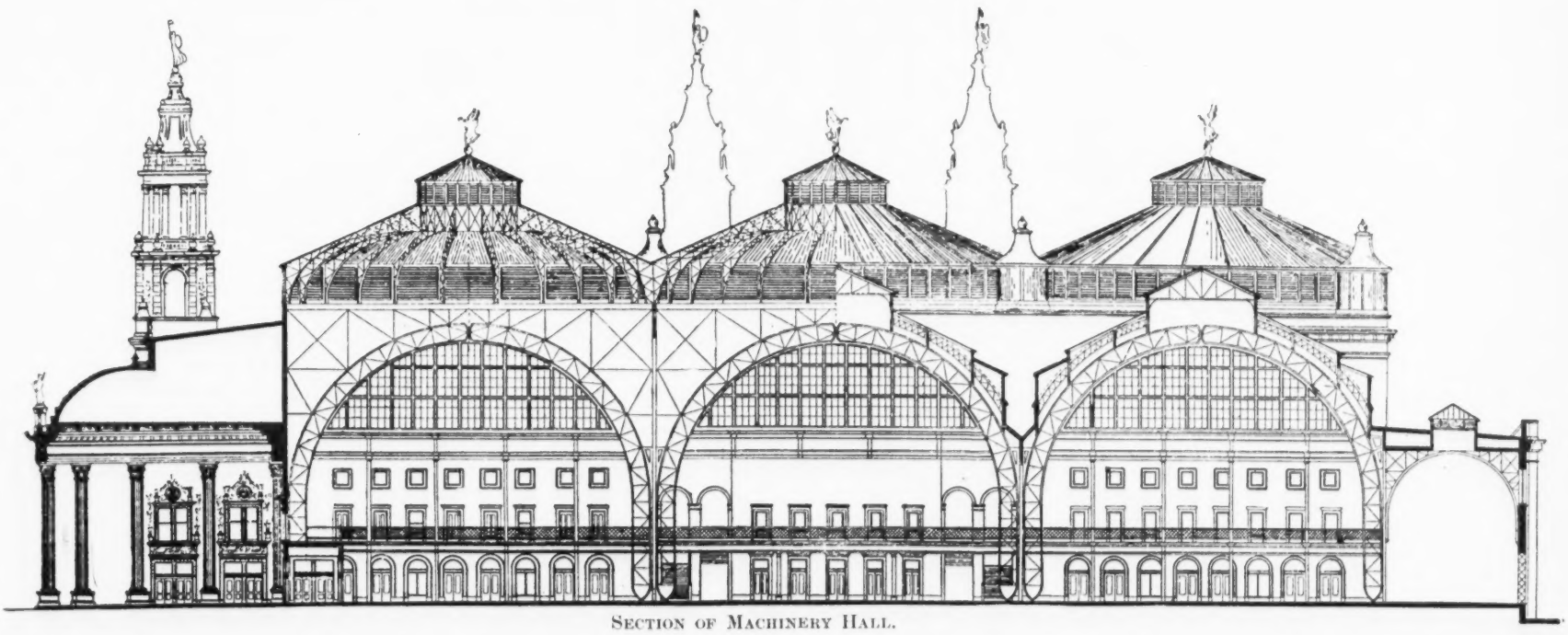
Machinery Hall at Chicago.

A very large majority of those who are in any way interested in machinery are interested in what bids fair to be by far the greatest exhibition of machinery ever yet organized, and we feel, therefore, no need to offer an apology for devoting so large a proportion of our space in this issue to giving our readers as good an idea as can be obtained at this time of how the machinery is to be housed, arranged, cared for, and exhibited. For doing this we shall depend mainly upon engravings, most of which have been made from working drawings, and are accurate representations of what they are intended to show.

Originally, Machinery Hall was to be 492x846 feet, and to have a floor space of 17.5 acres. This, it was supposed at the outset would be ample space in which to show all the machinery that would be offered for exhibition. Very early it was discovered, however, that this would be insufficient, and the architects, Messrs. Peabody & Stearns, of Boston, had to face the problem of how to add to the building, and yet preserve its architectural beauty. The result is what is known as the Annex, which is 490x550 feet, and adds 6 2 acres to the floor space, making 23.7 acres in all. The lumber used in this building amounts to 10,500,000 feet, and 11,000,000 pounds of structural steel has been used, the total cost of the building being $1,200,000. In designing this building one object has been to so arrange the roof trusses that they can be used for three separate buildings after the close of the Fair, and may be utilized for three or more train sheds, or for any similar purposes.



SIDE ELEVATION OF MACHINERY HALL AND ANNEX.



SECTION OF MACHINERY HALL.

In general appearance and construction, the building resembles three large train sheds placed side by side, being divided into three naves, each covered by an overhead traveling crane driven by electricity. These cranes will all be of 75 feet span, and will run the full length of the building. The passengers during the exhibition, thus forming a sort of three-track elevated electric railway from which the entire floor can be seen. The runways are made by the Edgemoor Iron Works, and upon these will be supported the line shafting, some lines of which will run at 120 revolutions, and others at 240 revolutions. Pulleys to go on this shafting will be furnished by the exhibitors, and are limited to 36″ diameter. At the south side of the building are the main boiler house, and the boiler house annex, in which the foreign boilers will be placed, west of these being the machine shop to be used for repairs during the exhibition; the blacksmith shop and the tool house as indicated.

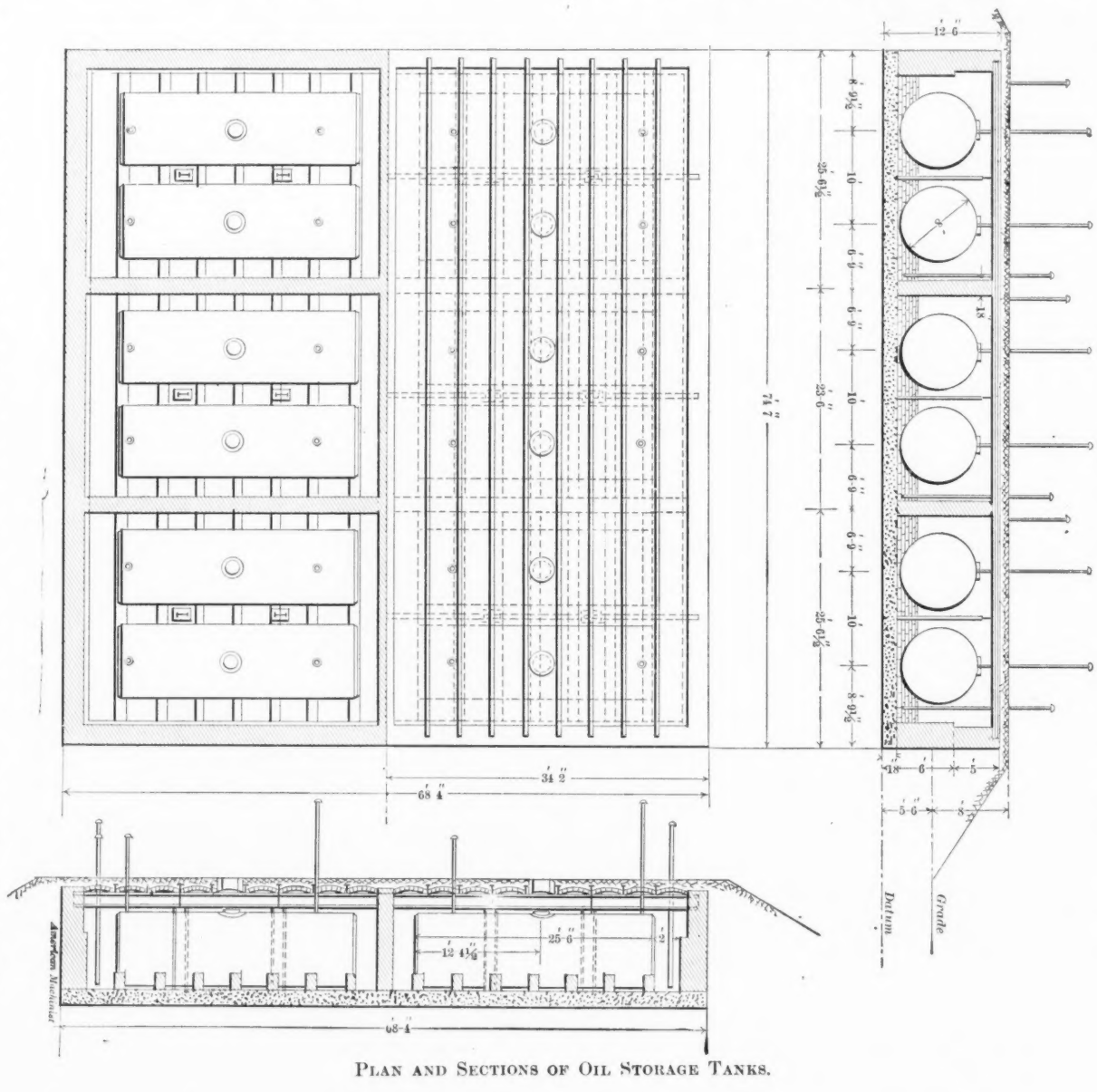
The location of the various boilers is also indicated in this view. The list of boilers, with the horse-power capacity reckoned at 30 pounds of water per hour per horse power is as follows: Babcock & Wilcox, 2,800 horse-power; Campbell & Zell, 3,750 horse-power; Gill, 1,500 horse-power; Heine, 3,750 horse power; National, 1,500 horse power; Root, 1,500 horse-power. Of these the Babcock & Wilcox Company have already in place two batteries of two boilers each.

Morgan Engineering Co., William Sellers & Co., and the Yale & Towne Manufacturing Co, have each built one of these cranes, which have been and are being used in putting the machinery in place, and will be provided with platforms for the use of

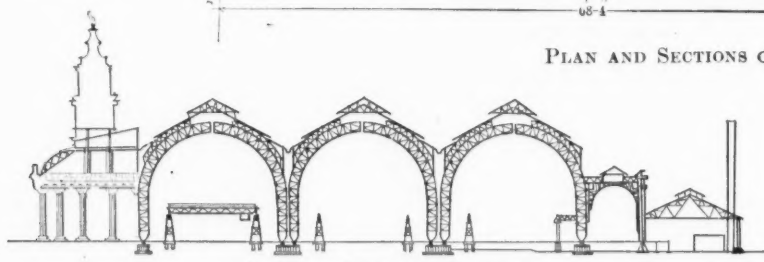
Adjacent to the boiler house, but within

the main building, will be placed the engines, which are located as shown on the drawing. The principal engines will be as follows: One 2,000 horse-power quadruple-expansion E. P. Allis & Co. engine, which will drive, tandem, two Westinghouse 10,000 incandescent light dynamos. Also one 500 horse-power engine, with Westinghouse dynamo direct connected. One 1,000 horse-power double-tandem compound, Atlas Engine Works; also one of same, 500 horse-power. Five Ball & Wood engines, aggregating 800 horse-power. One 350 horse-power cross-compound—Bass. One 1,000 horse-power four-cylinder triple-expansion — Buckeye Engine Company. There will be also five other Buckeye engines—three simple and two compound. One 1,000 horse-power Edison combined engine and dynamo. One 1,000 horse-power four-cylinder triple-expansion — Fraser & Chalmers. Two Ide engines, aggregating 800 horse-power. Two compound and one simple engine, aggregating 800 horse-power—Lane & Bodley. One 1,000 horse-power double-tandem compound—McIntosh & Seymore. One simple, one compound, and one four-cylinder compound—Phœnix—aggregating 850 horse-power. One cross and one tandem compound — Russell — aggregating 800 horse-power. Six 1,000 horse-power Westinghouse combined engines and dynamos. Two compound Woodbury engines, aggregating 800 horse-power. This is not, of course, a complete list of all the engines that will be exhibited there, but comprises the larger and principal ones, so far as now known.

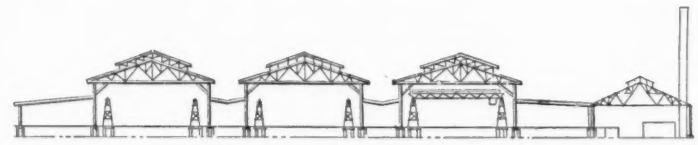
All piping for this hall will be run under the floor, the space under the main portion being 6 feet, and under the engines and dynamos 9 feet 6 inches.



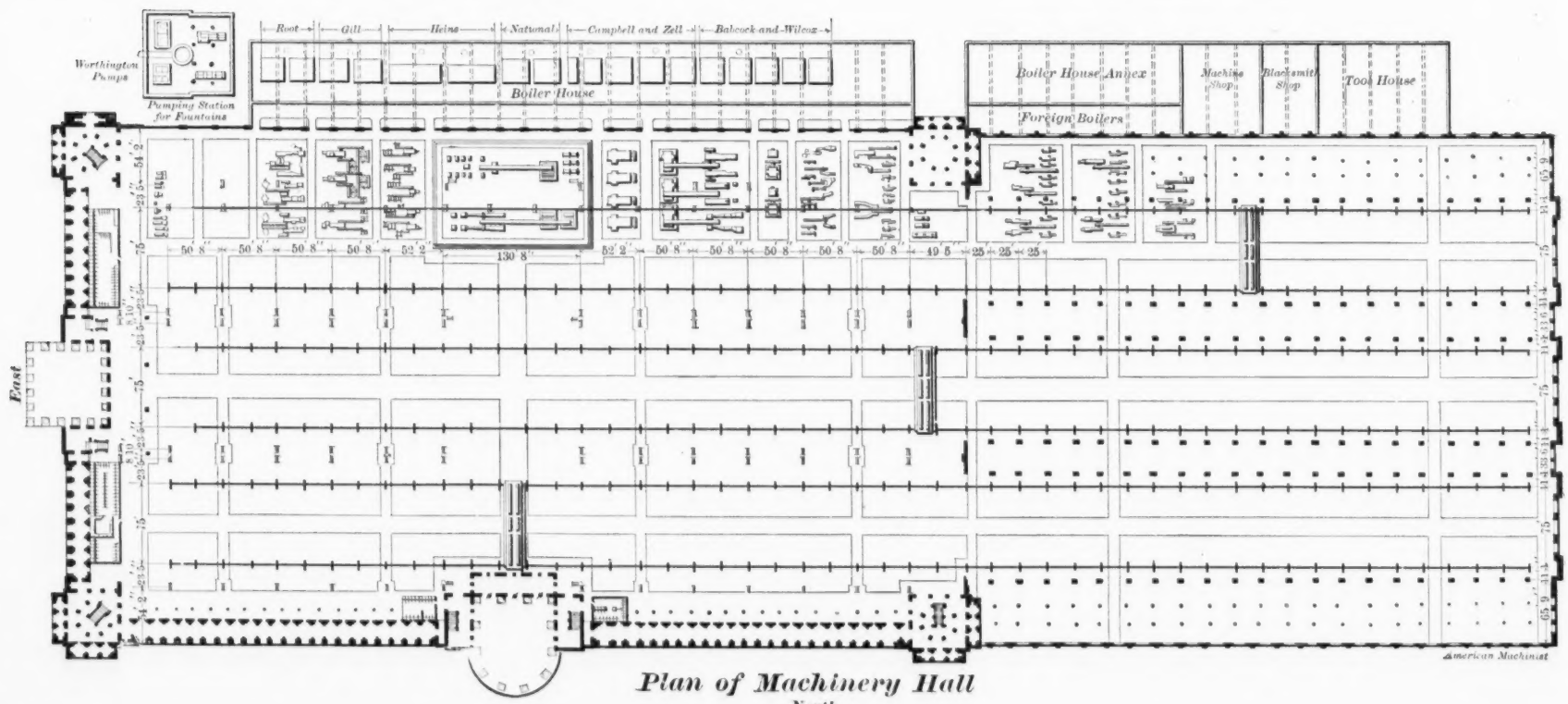
PLAN AND SECTIONS OF OIL STORAGE TANKS.



Section of Machinery Hall



Section of Machinery Annex



Plan of Machinery Hall

North

While most of the steam pump builders will, of course, be represented, the main service pumping stations will be equipped with Worthington pumps. One of these—a horizontal engine—will have a capacity of 12,500,000 gallons per 24 hours. Two vertical pumps—one with a capacity of 15,000,000 gallons, the other of 5,000,000 gallons; one of 7,500,000 gallons. For fire purposes there is a duplex pump, which will maintain a pressure of 350 pounds to the square inch. Practically all varieties of Worthington pumps will be represented by examples showing the latest practice.

The fuel to be used here will be oil, which will be piped directly to the exposition grounds from the Lima (Ohio) oil fields. Our engravings show the arrangement of the storage tanks where this oil is received, and which have a capacity of 120,000 gallons, which is about one and three-fourths days' supply. These tanks will be 2,800 feet from the boiler house, and from them the oil will be piped to the boiler furnaces, where its flow will be controlled by suitable valve arrangements. This, of course, will conduce very greatly to neatness and cleanliness about the power plant, since there will be no coal dust, smoke, or ashes.

Our engravings make the whole matter so plain that further detailed description seems unnecessary. To Mr. L. W. Robinson, U. S. N., Chief Machinery Department, and to Mr. F. Sargent, Mechanical and Electrical Engineer, are due an acknowledgment of our indebtedness for courtesies and help in arranging for placing this matter before our readers.

We have been rather constrained to believe that railroad accidents were in the main confined to this country. But recent accidents in England, by which about 20 lives were lost, demonstrate that there is no exact science—either there or here—in railroading. The most careful of men will make mistakes, and the results of these mistakes come along as the consequence.

The Builders' Iron Foundry, of Providence, R. I., have issued a very attractive pamphlet, called, "Our Share in Coast Defense," in which they illustrate and describe something of the methods pursued in the establishment in making 12-inch breech-loading rifled mortars and carriages.

Economy of Machine Shops for Electric Street Railways.*

BY JOHN F. BICKFORD.

The evolution of the electric motor has been so rapid that no definite methods have yet been established for its care and maintenance. There is a great lack of uniformity in the operation of roads, and one can hardly find two which are following the same course as regards repairs and renewals to motor equipment.

Outside of conductors, drivers and subordinate officers, the help on a horse line can be of a class which does not command a high rate of wages. Stablemen and trackmen are as a general thing employed for their muscle; therefore, I am not far from the truth when I say that previous to the introduction of electricity our street railroads were conducted with inexpensive help, and we have come to look upon this method as the only truly economical one. I do not present this as a criticism, only as a comparison.

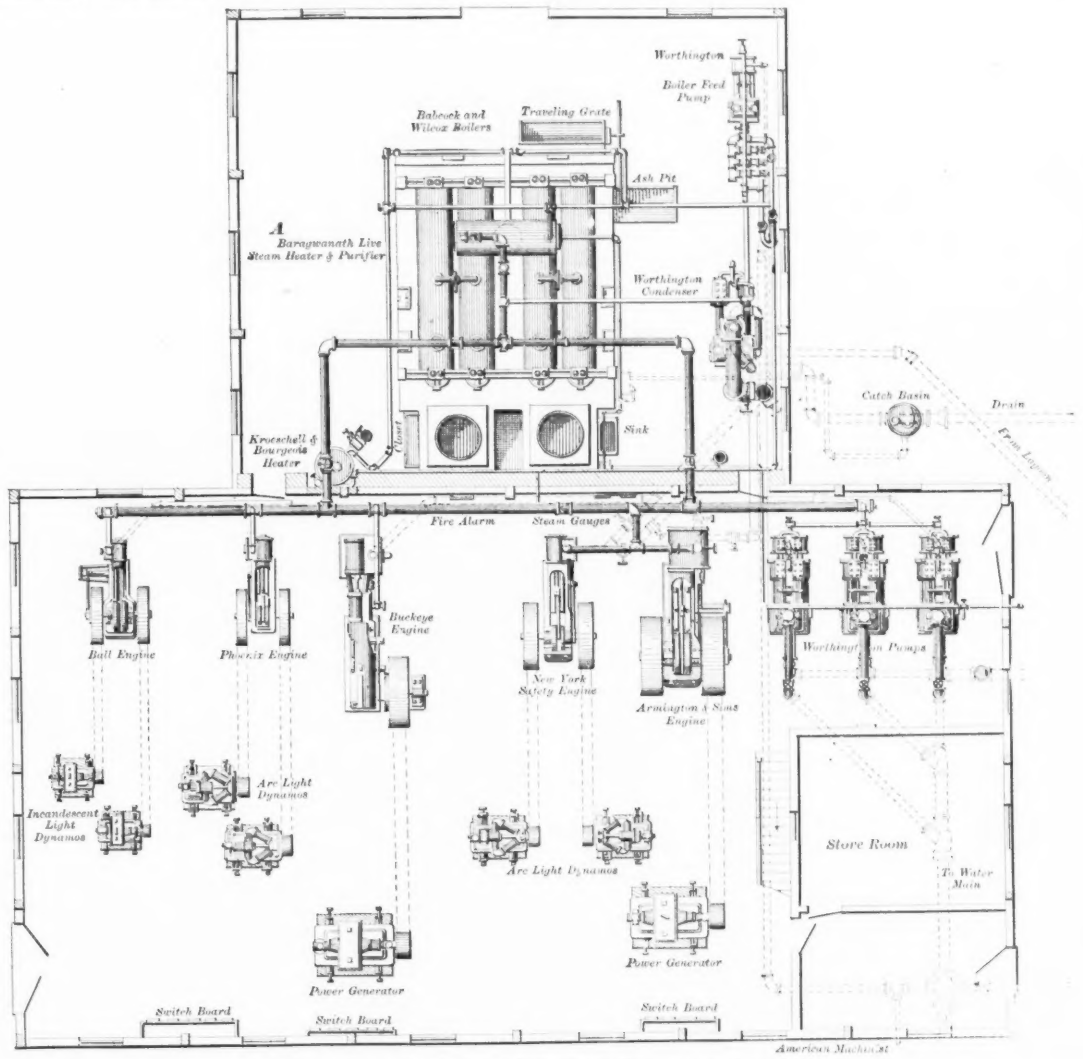
What shall we do now? Still employ the same class of help? Is it wise to place this apparatus in the hands of men who do not understand the first law of mechanics? No; emphatically, no; it would be the height of folly; yet I am sorry to say that such was the case with some of our roads in the early days of electrics. The laboring man is all right in his place, and is a necessary adjunct to a railroad, but until he educates himself to the level of the mechanic he should not be allowed to handle, much less repair, the delicate mechanism of an electric motor. Heretofore, then, we have been dealing with muscle, now we must have brains; hence we must turn our attention to the mechanic and the engineer.

Let us take one step more and look at the mechanic, and see if we should discriminate between men of this calling. We have two classes of mechanics: the thoroughly skilled class, and the partially skilled class; the latter more commonly called handy men.

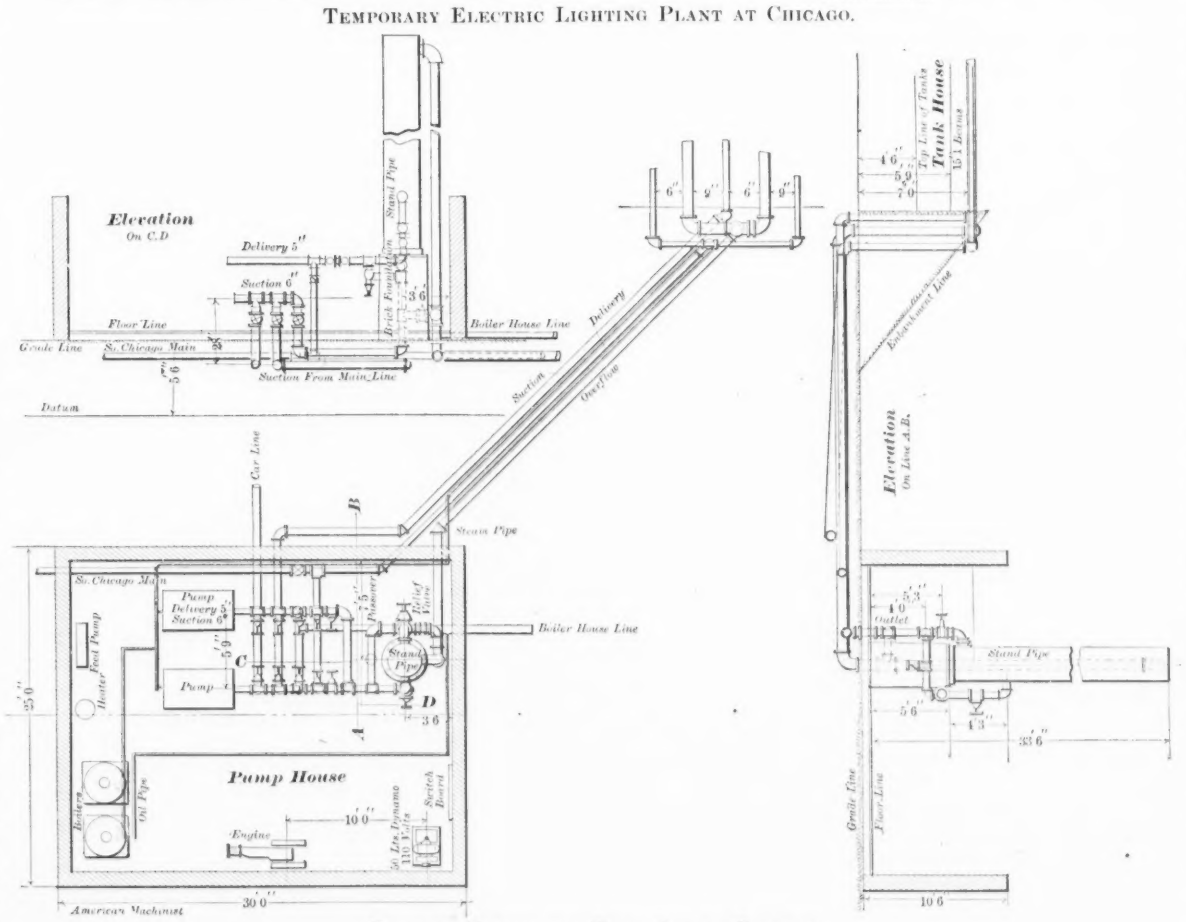
We have heard the old adage, "Jack of all trades and good at none," and do you not think that there is a grain of truth in it? However, there are exceptions in this class; some men are born mechanics, and could they have had the proper training would have become even more skilled than their brethren of the other class. Such men are worth employing for some purposes, but the man who can, in his own estimation, do anything, from the building of a motor to the framing of a house, seldom proves to be capable of doing either, and the electric road is better off without him. He never gains in knowledge, because he is satisfied in his own mind that he knows it all now.

Therefore I say we must look still higher for a class of men to care for and repair our electric machinery, and in doing so can only fall back upon the skilled mechanic. By the term "skilled mechanic" I do not necessarily mean a machinist. We have many kinds of mechanics. I mean a man who has learned a trade—has mastered some particular branch of the business, and applied himself to that exclusively. An armature winder is a skilled mechanic; so is a first-class line-man; that is his trade; he has mastered it, and knows every condition that enters into it. The same with the machinist and the carpenter. Hence, I say again, these are the men we must employ if we want to run our roads properly and economically; and right here we see, as stated a month ago, that true economy does not consist in what we save at the start; it comes at the other end of the transaction; it is what we save in repairs and breakdowns, which can be very materially lessened by the employment of the right means.

Having thus arrived at the conclusion that skilled help is necessary to success, let us look still farther into the subject and ascertain what else is needed to bring about true economy. Just here is where opinion will divide, and is what renders this subject difficult of elucidation.



TEMPORARY ELECTRIC LIGHTING PLANT AT CHICAGO.



PLAN OF PIPING FOR FUEL OIL AT CHICAGO.

skilled mechanic? Simply that we must provide him with the requisite tools and machinery to do the work in a skillful manner.

Now that we have arrived at this latter conclusion, there is yet another step, the last, but by no means the least. It is this: How far shall we carry this equipment of the machine shop? Shall we make it a manufacturing establishment? There is surely a point here where we must draw the line. There is a distinction between repairs and renewals; but for all this the question arises whether, if we go so far as to establish a shop for repairs, is it best to go a little further and manufacture supply parts?

In this connection I wish to call your attention to the methods and practices of the steam railroads. It seems to me that we ought to a certain extent to be guided by these people. They have spent over half a century in probing and sounding this matter of repairs and renewals, and even though we may not wish to follow their example in some things, it will surely be worth our while to consider what they are doing. We find here what we have arrived at through our conclusions, viz.: complete repair shops equipped with all the necessary machinery for doing the work in a thorough and economical manner, and manned by competent help; furthermore, a thoroughly competent master mechanic at the head of the whole. We find them manufacturing a great many supply parts, even complete cars and locomotives, and everything necessary for the maintenance of the road. They have learned by experience that it is economical to manufacture in this way. This is shown by their still continuing to do so, and, so far as certain repairs are concerned, they know positively that such can be done in their own shops more satisfactorily than in a local machine shop. Their own men having become familiar with all the requirements of the work, they know every condition under which the apparatus has to work, consequently the successful and economical operation of the road, so far as this department is concerned, is assured. In some instances it may cost a trifle more to make the article than it could be bought for. Suppose it does. If it will give better service and wear longer it is more economical. As I said at the beginning, economy does not always consist in buying a thing cheap. Happily, however, in the experience of the steam roads they have found that it costs no more, and in many cases not so much, as to buy of supply companies, which is surely a conclusive proof that it is economical to maintain shops.

After viewing the experience of the steam roads, let us turn our attention to the substantial practical data which I have gathered from the more prominent electric roads. Among these answers received from 66 roads I have found many things to strengthen my belief that it is economical to maintain a machine shop, not only for repairs, but for

There is no denying the fact that, to do a piece of work of any kind properly, we must have proper tools; a makeshift in such a case only leads to the abominable temporary hitch. To do a thing half way results in gross extravagance in the end. There is no denying this; we have samples of it already on the electric railway. If this be true, what conclusion follows, in view of our previous conclusion—that we must employ the

*Abstract of a paper read at the Cleveland meeting of the American Street Railway Association.

the manufacture of supply parts. It turns out to be a fact that no less than 24 roads are maintaining machine shops, doing all their own repairs, and manufacturing many supply parts. They say unhesitatingly that there is economy in so doing. They give as their reasons: First, that they can make better material than they can buy; that they are perfectly familiar with the requirements and conditions of the business; they are operating the roads, and are in a position to know just what is needed, and are better able to judge of the strength and durability of the apparatus than those who have never been in a similar position. Is not this a natural consequence? A second reason given is, that there is a saving of from 25 to 50 per cent. by manufacturing the majority of parts.

What further, then, can we say? Is not this, coupled with the experience of the steam roads, sufficient to enable us to conclude that there must be economy in machine shops for electric street railways?

Out of the 66 roads heard from, 36 were winding their own motor armatures and field coils, and the cost of armatures varied from $17, the lowest, to $75, the highest; the average was about $35, including all labor and material. Fifteen roads had woodworking machinery, consisting principally of saw table, band saw, surface planer and mortising machine. Seven roads are cutting their gears, but some of them find it no cheaper than to buy. They think, however, that the work and material are better, and for that reason it pays them. Others make all gears and think there is a saving in cost. Eight roads are building their cars, while several are rebuilding old cars, but make no new ones.

I will give now a few of the prices for which supply parts are being made in the shops of the different roads. These figures are an average taken from 11 roads which are using Sprague, Thomson-Houston and Westinghouse double reduction motors.

Refilling commutator (copper bars)	$18 50
Two halves armature bearing, T.-H., $3.96, single Sprague	1 85
Two halves axle bearing	3 50
Brush holder	1 35
Rocker arm, T.-H., $1.00; Sprague	3 00
Int. shaft (steel), T.-H., $10; Sprague	3 00
Int. pinion (steel)	4 20
Int. gear	3 88
Axle gear	5 66
Armature pinion (steel)	3 58
Trolley wheel (brass)	1 06
Line frog	1 90
Clips for line hangers (brass)	15
To bore and press on 30-inch wheel	95

The average price for which roads sell scrap car wheels is $13.65 per gross ton; the lowest being $8 and the highest $20.

Being anxious to know, myself, and thinking it might be of benefit to many others, I asked the roads to give an opinion as to which of the different types of motors gave them the most trouble. With but two exceptions, the single reduction cost less to maintain.

Nineteen roads are employing an electrical engineer, and four have a superintendent and electrical engineer combined.

I will not attempt to recommend the number and kind of machines a road ought to have, as it will depend largely on the number of cars they operate; but I have made up a list of machines which I find the majority of those having machine shops are using, and should judge that it covers those most necessary for the work.

One 20-inch swing, 10-foot bed, engine lathe; one 16-inch swing, 6-foot bed, engine lathe; one 16-inch swing, 6-foot bed, speed lathe; one 24-inch by 24-inch iron planer; one No. 3 or No. 4 Universal milling machine; one 45-inch upright boring mill; one 24-inch upright drill press; one 12-inch upright drill press; one 100-ton hydraulic wheel press; one open die bolt cutter and nut tapper; one medium size shaper; one tool grinder; two forges with power blower; one set of emery grinders; one grindstone; necessary bench tools and fittings for machines; one 10-h.-p. motor to run machinery. Of course, roads with a greater number of cars would need to duplicate some of these machines and add some others not mentioned.

After having considered this subject and shown you what conclusions have been arrived at, both theoretically and practically, I want to add that, in order to make a success of running a machine shop in connection with an electric road, it will be necessary to employ an electrical engineer. By this I do not mean a handy man, or a man who styles himself an electrician, just because he has had a few months' experience in the electrical business, but one who has a theoretical

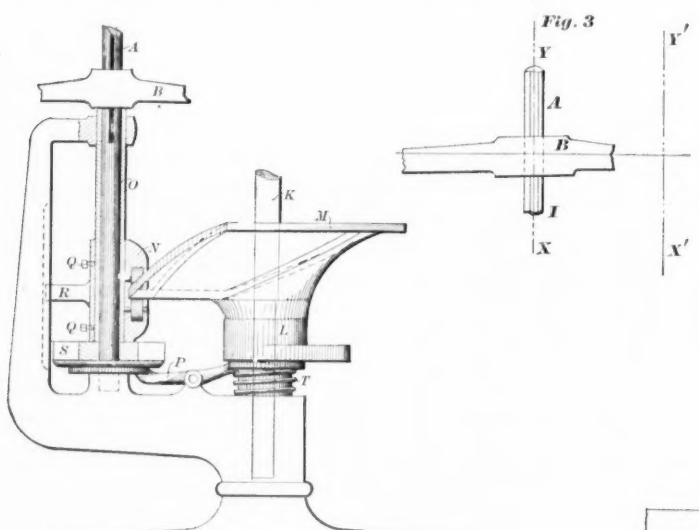


Fig. 5.

Fig. 3.

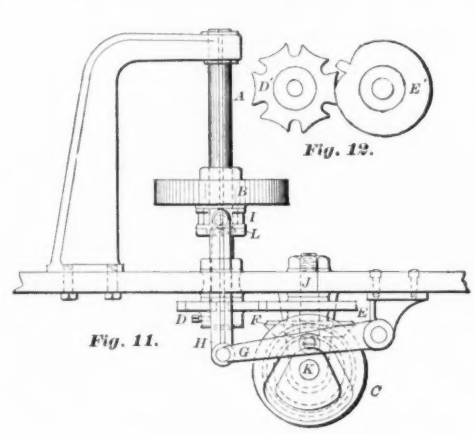


Fig. 11.

Fig. 12.

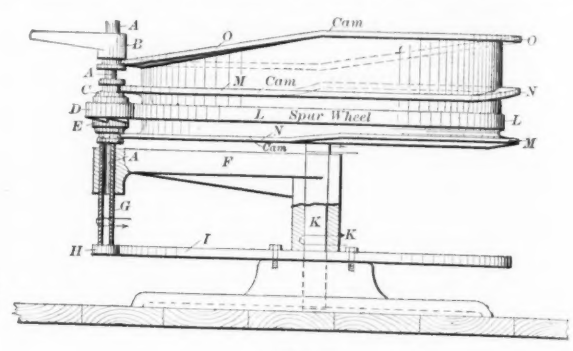


Fig. 4.

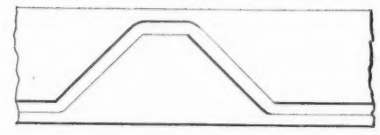


Fig. 10.

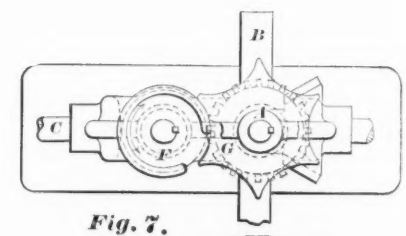


Fig. 7.

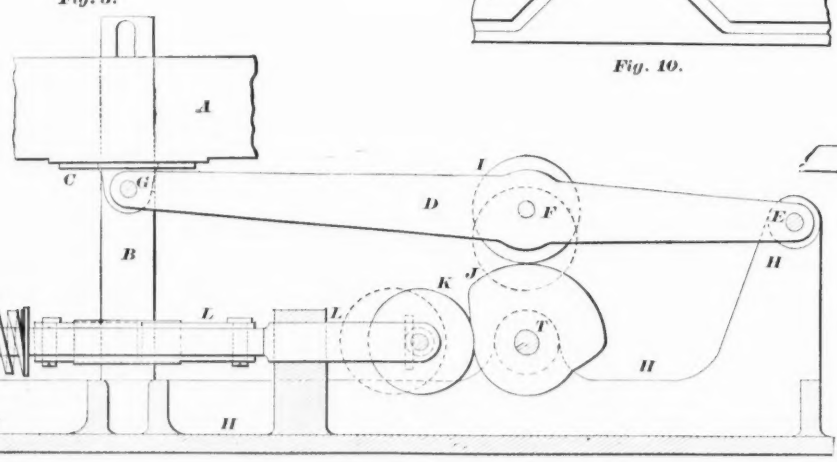


Fig. 1.

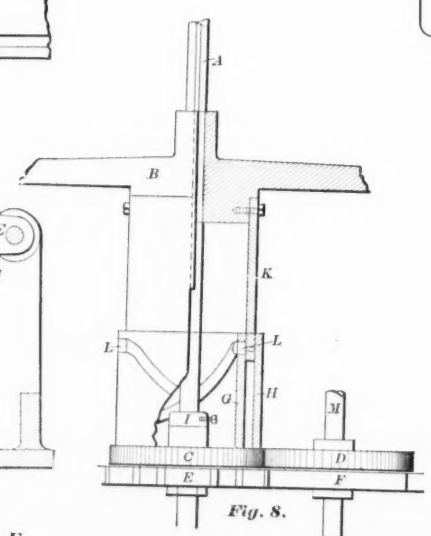


Fig. 8.

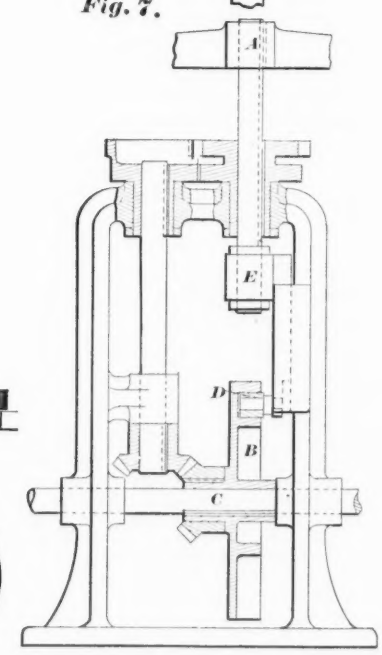


Fig. 6.

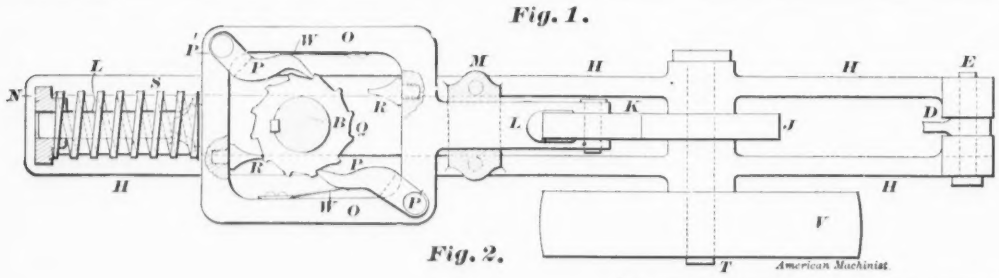


Fig. 2.

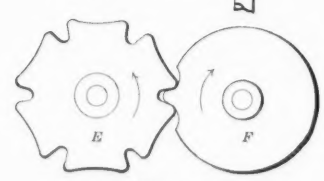


Fig. 9.

American Machinist

ON THE CULTIVATION OF THE INVENTIVE FACULTY

On the Cultivation of the Inventive Faculty by the Solution of Constructive Problems.

BY LEICESTER ALLEN.

A good solution of the problem given out in the AMERICAN MACHINIST for July 28th has been devised by Mr. Percy J. Neate, Consulting and Mechanical Engineer, Rochester, England.

This solution is illustrated in Figs. 1 and 2, Fig. 1 being a side elevation, and Fig. 2 a partial plan.

The hub is shown at *A*, Fig. 1, splined on the shaft *B*, as demanded by the conditions of the problem. The vertical movement of the hub is effected by a lever *D*, whose fulcrum is the pin *E* in a support that rises from the bed-frame *H*. Power is applied to the lever *D* by a cam *J*, acting against the roller *I*, pivoted to the lever *D*, at *F*. At *C* is attached to the lever *D* a lifting collar loosely fitted under the hub, and having sufficient play on the shaft *B* to allow the radial movement of the lever *D* on the pin *E* as a center.

The cam *J* is keyed to the shaft *T*, the latter being driven by the pulley *V*.

The cam *J* also acts against a roller *K* pivoted to the forked end of the slide *L*, which, moved in one direction by the cam, is moved in the opposite direction by the spring *S*, the slide being made to reciprocate in the guides *M* and *N*.

Formed with, or attached to the slide *L*, is a rectangular frame *O*, in the interior of which is placed the ratchet *Q*, this ratchet being keyed to the lower extremity of the shaft *B*. To opposite corners of this frame are pivoted the pawls *P*, which are made to engage the ratchet teeth by springs *W*. To the frame *H*, below the pawl-frame *O*, are attached stops *R*, which, at the proper periods, alternately abut against the back side of a ratchet tooth, and thus limit the horizontal rotation of the hub, which is partly accomplished during the advance of the slide, and partly by the retreating movement under the action of the spring *S*. A good, strong, and positive movement of the hub in the manner demanded by the problem can be thus obtained.

Mr. Neate writes:

"Had it not been for delay of transmission by post, I should have written to ask if the vertical shaft revolved always in the same direction, or backward and then forward. Not being clear on this point, I took the most difficult interpretation, and provided for rotation in one direction only.

"I have not gone into details of the curves on the cam, which, of course, would be set out to give uniform acceleration and

retardation to the velocity of the moving parts.

"I fancy the stops for checking any tendency for the shaft to rotate too far are a distinct novelty, and might be applicable to automatic counting machines working on the ratchet plan, where certainty of action is a desideratum. I will be glad to learn if Mr. Allen agrees.

"I heartily indorse Mr. Allen's views as to the educative effect of these solutions. I made my pupil draftsmen carefully read the problem before working on my hand sketches.

"Might I, however, without offense, suggest to Mr. Allen the educative effect of being compelled to set a problem that shall not be misunderstood? I know of no harder task, and, indeed, it seems to me that to ask the problem correctly is harder than to solve it."

I am glad to receive Mr. Neate's suggestion, and first applying it to myself, I will say that I have indeed found it difficult, concisely, and at the same time without ambiguity, to express the requirements of a particular mechanical construction. I hope I am enlarging my education in the discussion and enunciation of these problems, as much as or more than any who read them or solve them. I have little hope for the future of any man who regards his education completed, and I am certainly far from any such assumption. I hope that, by those who can appreciate the difficulty pointed out by Mr. Neate, any shortcomings in my statements of problems will meet with excuse, and that, as we proceed, deficiencies will gradually be avoided.

With reference to the stops *R*, they are, so far as I know, new in their application to a ratchet wheel, and, doubtless, they might be useful for the purpose suggested.

Another gentleman who has discovered an ambiguity with reference to the horizontal movement of the hub, and has, I think, misunderstood the problem in points wherein justly no ambiguity can be charged, is Mr. Baxter Aslakson, of Waynesboro, Pa.

Referring to Figs. 3, 4 and 5, Mr. Aslakson writes:

"The motions which I deducted from Mr. Allen's statement of the problem are as follows:

"1st. *A* rotating on axis *X Y* while *B* is ascending at the same time.

"2d. *A* rotating on *X Y* while *X Y*, and with it *A* and *B*, rotate around another parallel axis *x' y'*.

"3d. *A* rotating around *X Y* while *B* is lowered.

"4th. Both *A* and *B* at rest.

"It seems perfectly reasonable to deduce the above motions from the original statement of problem, and my device was designed to furnish them, which it does. These motions are more complex than those I now know Mr. Allen intended, *but still my device falls within the limited number of elements*, 13, while some of those given in the AMERICAN MACHINIST of September 28th—with less complicated movements—do not.

"In Fig. 4, *K* is the driving shaft on which is keyed the spur wheel *L*, carrying cams *M*, *N* and *O*. *L* meshes into *D*, which is loose on the shaft *A*. The cam *O* raises and lowers *B*. The cam *M* controls the clutch *C*, which is keyed loosely on *A*. When *C* is closed, *A* rotates about its own axis. The cam *N* controls the clutch *E*, which is keyed to the hollow shaft *G*. When *E* is closed, *A*, by means of the pinion *H* and stationary spur *I*, will rotate around the axis of the shaft *K*. The four above stated changes in motion occur during one revolution of the shaft *K*.

"The shaft *A* works loose inside the pinion *D*, as above stated, and also inside the shaft *G*. If *K* turns in the direction of the hands of a clock, *A* turns oppositely on its *own axis*, and also *rotates around the axis of K* in the same sense.

"In this device, the motion of *A*, relatively to the base, is altered during that period of the cycle when *A* rotates about the axis of the shaft *K*. In order to prevent the friction of the gearing from carrying all in same direction as the motion of *K*, when the clutch *E* is free, a ratchet may be used.

"Fig. 5 is devised to give the motions called for by those represented in the issue of September 22d.

"*K* is the driving shaft keyed to cam *M* and arm *L*. *M* is made to give vertical motions at the proper time transmitted by the rollers on *N*, and collar *O* to hub *B*. *N* is fastened to the shaft *A* by set-screws *Q*. *R* is a part of *N*, traveling in a slot, and it keeps the collar *O* from turning. Rotation to the shaft *A* is given by means of arm *L* and starred wheel *S*. *P* is a lever for overcoming the inertia due to the rotation of *A* immediately after *L* ceases contact with *S*. It is moved by a cam on the under side of *P*, and the spring *T*. It engages *S* by means of small notches. Very little vertical motion is necessary for *P*.

"It would seem that this device gives very positive movements all around, allowing a high velocity if required."

To show Mr. Aslakson and others that I intend perfect fairness in the treatment and discussion of all solutions forwarded, I have presented both his solutions. In a letter accompanying the one illustrated in Fig. 5, he expresses the supposition that the reason the solution illustrated in Fig. 4 had not yet been published with others was that it gave movements not called for by the terms of the problem; and as I consider that it gives motion where the problem prohibits it, not merely by implication in not requiring the motion, but in express terms, it would probably have been the fate of the solution to be passed with only a critical mention, had it not been for Mr. Aslakson's challenge of the problem, holding as he does that the four motions described by him above are reasonably deduced "from the original statement."

The motion of *A* rotating on the axis *X Y* during the lifting of the hub is certainly not required by the problem; by implication, it is therefore a redundant motion. It would scarcely be possible in stating a problem to prohibit expressly all possible motions other than those positively demanded. So far, Mr. Aslakson is the only one who has seemed to suppose this movement either required or permitted.

With reference to his second deduction, I admit there is an ambiguity in the problem as to the horizontal rotation of the hub after it has been lifted; and I have rejected no solution simply because that part of the problem has been interpreted by some as meaning rotation simply in one direction, while by others it has been understood to mean rotation first in one direction and then in the opposite direction; or while some, like Mr. Aslakson, have taken it to mean that the rotation of the hub was intended to be about some vertical axis exterior to and parallel with the axis of the vertical shaft carrying the hub.

As to the third motion claimed by Mr. Aslakson, the statement of the problem (see issue of July 28) says, "The hub is to be lowered, *without rotation*," to its first position.

I now leave it to the readers of these problems and solutions to decide whether I would have been unfair or unjust in rejecting the solution shown in Fig. 4.

The real reason, however, why the solution in question had not been yet noticed, when the letter of Mr. Aslakson was received, was that it had not yet been reached among a large number of communications from others.

This gives me an opportunity to say what I perhaps should have stated earlier, that delay in presentation is not to be taken as a rejection of any solution. I find it impossible to treat these answers to problems all at once, or even in the exact order of their receipt. Something has to be allowed for the exigencies of space and for the general *ensemble* of each article. There are also some solutions that, while accurate, may be described without drawings, and which, for some reason, as incomplete description, defective drawing, etc., would require too great an expense of time and labor to prepare for publication. By defective drawing I do not mean defective execution, but want of clearness as to details; so that while, perhaps, the general principle is discernible, to elaborate the details sufficiently for a creditable representation in an engraving exacts more time than can be afforded for the purpose.

One defect in drawings sent in, to which I would direct attention, is the use of dark yellow paper, the drawing or sketch being in pencil. *White* paper is in all cases to be preferred; but yellow paper is not very objectionable if the sketch is inked in.

Mr. Gilbert Wright, whose address did not reach me with his solution, has devised a very good movement, of which Fig. 6 is an elevation and Fig. 7 is a plan view. His description follows:

"The vertical movement of the hub *A* is effected by the cam *B* on the driving shaft *C*, which, acting on the roll *D* on the lower end of the sliding bearing *E*, gives the shaft on which the hub is mounted any desired vertical motion by varying the form of cam *B*. The rotary movement is effected by the two-toothed gear and flange *F* acting on the star wheel and gear *G*, by and through which the vertical shaft on which the hub *A* is mounted is driven and slides. The star wheel and gearing can be varied to effect a great variety of movements."

It will be noticed that in this solution use has been made of the Geneva stop movement in a slightly modified form, which it will be instructive to compare with the more simple solution of Mr. Albert D. Colburn, given in a previous article.

Another gentleman who has perceived the possibilities of the Geneva stop is Mr. C. S. Beach, who has favored us with the solution shown in Figs 8, 9 and 10; Fig. 8 being a partly sectional elevation; Fig. 9 a detail plan of the stop movement, and Fig. 10 the development of cam grooves for the lifting movement. The explanation given by Mr. Beach is clear and concise. He writes:

"As one of the many possible solutions of your problem in the July 28 issue of AMERICAN MACHINIST, I inclose the sketch herewith, and offer the description also inclosed. This construction is the first that came to mind, and somewhat simpler than others I have thought of. It would likely do fairly well on light work If I make no mistake, it contains but four elements, as per your definition.

"I would say I think you are doing a good work in offering these questions and publishing the various solutions; it is wonderful how different minds grasp the idea and shape the means to accomplish the same results. I trust you may continue with these problems."

In the drawings, *A* is the shaft and *B* the head, as in problem of July 28. *C* and *D* are a pair of plain spur gears of equal size. *E* and *F* give the horizontal rotative motion, and constitute the Geneva stop as met with in some watches. *G* is an inside and *H* an outside cylindrical cam having grooves for the rollers *L*. These cams are fast to the gear *C*. *I* is a collar to prevent the cams being drawn along the shaft. *K* is a cylindrical sleeve fast to *B*, and carrying the rolls *L* that run in the grooves in *G* and *H*. *M* is the main driving shaft having *D* and *F* secured thereon. *E* is secured on the shaft *A*. *C*, *G* and *H* are secured together, but they revolve loosely on *A*. *B* and *K* are secured together, but slide longitudinally on *A*. The rolls *L* are secured to *K*, one running in *G* and one in *H*, to secure opposite driving and balanced strains. *G* and *H* are alike as regards the cam motions.

In action the cams *G* and *H* revolve continuously, raising and lowering the head *B* during each revolution, with a wait or rest after each; while *B* is at its highest point the single tooth gear *F* engages with the stop gear *E* and advances it one space. During this movement the cams *G* and *H* revolve at the same speed as the shaft *A*, consequently they hold the head *B* in its raised position. The gears *C*, *D*, *E* and *F* are of equal pitch diameters, *D* and *F* being secured together.

"It will be seen that this construction admits of a variety of motions by changing the ratios of the gearing and the shape of the cam grooves."

Figs. 11 and 12 represent another excellent solution from Mr. E. A. Moyer, of Hartford, Conn., who also expresses great interest in these problems.

As described by Mr. Moyer, the device is as follows:

In Fig. 1, *A* is the upright shaft and *B* is the sliding hub. The power is applied to the shaft *K*, and the elevation of the hub is effected by the cam *C*, which is designed to give an equal period of rest at the top and bottom, the cam lever *G*, and the connecting piece *H* which passes through a hole in the bed. The hub *B* has on its lower end a swivel *I*, held in place by the screw collar *L*, so that the hub is allowed to turn with the shaft. The rotation of the shaft is effected by the wheels *D* and *E*, the action of which will be understood from the plan of them given in Fig 2. *E'* is the driver whose single tooth at every revolution enters a space in the wheel *D'*, carrying it forward one-sixth of a revolution, when it is held positively by the periphery of *E'* in contact with the concave facets of *D'*. In Fig. 1 it will be seen that the wheel *E* derives its motion from the shaft *K* through the medium of miter gears, one of which (*F*) is joined to *E* and supported by the stud *J* which passes through the bed and held by the nut shown. The cam *C*, or the gear, should be fastened to the shaft *K* by a set-screw, to allow of adjustment, so that the moving parts may be timed to move in their proper order.

There are still some other solutions of this problem to be noticed prior to announcing another problem.

LETTERS FROM PRACTICAL MEN.

Bursting of Emery Wheels and Boilers.

Editor American Machinist:

Mr. Grant makes some remarks upon the bursting of an emery wheel so very much to the point, and so clearly explanatory of the cause of bursting, that his further remarks about steam boiler bursting appear the more strange by contrast. There are a good number of the readers of the AMERICAN MACHINIST who would be as likely to slightly alter Mr. Grant's words, and say that they were obliged to suffer an emery wheel in their place, even if it might burst, because they could not well get along without one, but a boiler liable to burst they would not tolerate. Mr. Grant would teach such as these that very many burst emery wheels would not have burst had they been made of the same quality of material slightly varied in shape, and some recent experience with emery wheels inclines me to believe Mr. Grant to be correct. But those of us who are less acquainted with emery wheels will be disposed to disagree with him as regards the boiler. Mr. Grant says in effect that a boiler may or may not explode, but that he must take the risk of it because he cannot do without a steam boiler. Now of the two articles there is in the nature of things less risk of explosion of a boiler than of an emery wheel. In the first place, a boiler can be made of good material and it can be made of good shape—of a shape recognized as good by reason and experience. If made otherwise it is easy to be found out by an expert, whilst the use of a good brand of plate can be insisted upon. More than this the emery wheel cannot have. When we consider the defects due to work, wear and tear, it can be truthfully said that the defects of a steam boiler are more easily discovered than are defects in an emery wheel. It is very questionable indeed if any boiler ever exploded from any structural defect, from corrosion, or from faulty safety valves or other fittings, which could not have been discovered by inspection at reasonable periodical intervals. It is now nearly 40 years since serious endeavors were first made in this country to place boiler making upon a sounder basis than it had hitherto occupied, and to teach steam users and the public generally that there was no mysterious cause of boiler explosions. With occasional exceptions it is very generally held now that boilers explode when they are too weak for the pressure within them, or, as an engineer once said, when there was "more steam inside them than there was room for." In the 40 years the alterations made have not been very large, though they have been important.

In the structure of the boiler itself the chief alterations have been in the direction of providing against expansion stresses due to the action of heat upon different portions of the boiler causing differential movements. In details there has been the improvement in the riveting and in the making of the rivet holes.

In the furnaces, where circular, attention has been given to the production of a truly circular form, and there has been abandoned the old practice of cutting huge openings in the shell for steam domes and cast-iron mouth-pieces with their large but limited coefficient of elasticity.

Outside the boiler has been the provision of proper seating blocks, and the abandonment of wide brick seats which accumulated moisture and corroded the plates. In fittings we have vastly improved safety valves and attention to their outlets, more than one explosion being traceable to the freezing up of a safety valve outlet pipe carried perhaps through a wall and out of view.

Generally, too, a boiler has become less of a mechanical pariah than formerly. Any damp hole in a dark cellar is not now considered fit for the reception of a steam boiler, although in this respect I regret to say there are still too many architects who provide the worst part of a building for steam plant, unless they are expressly enjoined otherwise.

With the knowledge at hand there is absolutely no reason for boilers to explode. There are reliable safety valves and there are reliable fusible plugs if reasonably attended to. A fusible plug is not much good if it is covered by a heavy scale. Now there ought to be no heavy scale in a boiler, and scale is the greatest danger to which boilers are now subject. Feed waters for boilers are of two kinds—acid and calcareous. The former can be cured by a sufficient use of alkali; the latter can be softened. Carbonate of lime, perhaps the most frequent scale, can be removed perhaps more cheaply than any other before it enters the boiler, and I have seen where a single boiler was kept free from scale by the use of the most simple apparatus, merely two small tanks for lime treatment and deposit. This question of scale in boilers is one of the most important to the steam user, for scale is very costly in fuel—far more so than purification; for not only does it reduce the efficiency of the fuel, but it involves blowing off a quantity of water which has been heated to 300° or more; and when we consider that, except in cases of acid water and others requiring soda treatment, there is no need for opening the blow-out tap at all, the waste thus caused is seen to be very great. One hears at times complaints about the competition of foreigners in various trades. I have heard their success in dyeing textile fabrics attributed to their clear skies. Now I don't believe a word of this. A few days ago I had pointed out to me a man who is making a good thing in dyeing a certain very delicate color, and this man does not care one cent for the foreigner, simply because he has a very bad quality of water to use, and he makes it good by suitable treatment, and this, says he, is all that the foreigner does to secure his success.

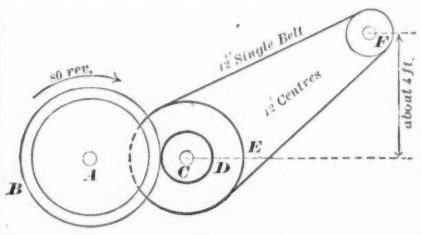
A large manufacturing concern has been recently closed. Some people attribute this to the action of the American McKinley tariff. When the factory was built it was a model concern, and concession to appearances placed the steam boilers underground in a most inconvenient place. No manufacturer of sense would to-day copy that arrangement, and it is very certain McKinley had no hand in keeping them there. It is very certain that the difference between a profit and a loss will often be found in the cost of steam power production. To secure economy in this direction we ought to set out with the conviction that a boiler is not an article that is liable to explode.

W. H. BOOTH.

A Case of Friction Gearing.

Editor American Machinist:

In the matter of the transmission of power by means of wheels in rolling contact, I can say that I have made and used many, and that there is no better way when circumstances admit of their use. The two enemies of this kind of transmission are eccentricity and elasticity. The first can be got rid of by good workmanship; the second without much trouble if the shafts are parallel, but when change of direction requires conical gears the problem becomes much more difficult. If we compare the action of cylindrical gears with that of a straight belt, we may compare the action of conical gears with that of a quarter-twist belt. Under the best conditions the pressure required to get the "bite" is so small as to be *insignificant*. If, however, there be one springing member



in the system, no amount of pressure will produce equally satisfactory results, though it may give enough to answer. Of all the materials possible, from india rubber to cast-iron, only three need to be considered—paper for small drivers, side grain of soft wood for large ones, and plain turned cast-iron for the driven gears. The ideal driver would be of soft wood, say soft maple, basswood or white wood, bent to the proper curve. As these woods do not bend kindly, we can get a sufficient approximation by building up a rim of short segments, well glued or painted together and thoroughly nailed. If these segments are not over $\frac{1}{8}$ of the wheel's diameter in length, and not over $\frac{1}{8}$ of its face in thickness, the driving power will be all right. With such a wheel running on well-turned cast-iron, contact being insured by a screw, or its equivalent, and no elasticity in the system, the amount of power well within its ability to transmit will certainly be *three* and probably *five* times what a single leather belt would handle under the same conditions of speed and surface. The sketch shows an outfit that was used a long time for running some very high speed machinery. It was stopped and started thousands of times, and showed no signs of wear. As the high speed acquired gave a great leverage, taken in the opposite direction, it was common to use it, during repairs, to turn the whole mill, 150 H. P. engine included. The "bite" was just as effective at the slowest as at the highest speeds. All the pressure needed could be put on by grasping the body of the $1\frac{1}{4}$" screw with the bare hands, and giving a quick effort. This would not only start the heavy pulley *instantly*, but would make the belt "skitter" around the line shaft pulley as though running on rollers. Here we have a 12" belt slipped by a 10" face friction running at $\frac{1}{8}$ of the speed of the belt, or a ratio of $3\frac{6}{10}$ to 1 of effect. The setting-up screw had 6 threads to inch, and it was limited to about $\frac{1}{8}$ of a revolution by stops. There was no throwing-out device needed. In the sketch, *A* is the 6" line shaft running 80 rev., *B* wood wheel on strong cast-iron spider. The rim was 10" face, 8" deep, and 64" diameter; *C*, a $4\frac{1}{2}$" shaft about 4 feet long, journals $2\frac{1}{2}$" diameter; *D*, the body of an old spur pinion, 10" face 16" diameter, smoothly turned, but not polished; *E*, an old fly-wheel pulley, 48" diameter by 13" face, rim about 1" thick; *F*, 18" pulley on second line shaft. One box of shaft *C* slid in a sole plate, and was set up by a $1\frac{1}{4}$" screw of 6 threads. This screw carried a straight-tailed dog working between two stop-pins. Only $\frac{1}{8}$ of a revolution was used.

SUPERANNUATED.

Core Box for Draw-bar Pattern.

Editor American Machinist:

Every pattern maker knows that the life of a pattern or core box that is in constant use is very short, if more than ordinary thought and care are not given to its construction. Indeed, I believe the core box generally suffers most. I have made them of cherry, ash, and other hard woods in this country and in England. If pine is not used, we usually resort to mahogany (Honduras), but all have proved more or less a failure if not protected in some way. A little while since, we had to renew the core box of draw-bar pattern shown in the annexed sketch, and I made it on the somewhat novel plan given below. The material for the principal part was white pine with hard wood ends, the latter about $1\frac{1}{4}$" thick, faced with No. 12 sheet-iron, and held in place by $1\frac{1}{4}$" screws. Then I turned some pieces of hickory, as seen at *a*, *b* and *c*, about $1\frac{1}{4}$" diameter, with the grain running parallel with the axis of each. The pieces *a* and *b* are intended for the core maker to rap on only, whilst *c c* are to be used for handle as well, thereby making it easier to roll over and turn core out. The pieces *a a* do not project beyond the surface, simply to allow the bottom of box to lie flat on bench. The reason that the bottom of hole *d* is not covered, is to allow the core maker to see if the core is leaving the box without leaving that particular part behind. I am certain, if care is taken not to strike the box elsewhere than on those pieces which are specially provided for that purpose, its usefulness will be considerably prolonged, and, as it takes but a short time to bore the holes, turn the pieces to a snug fit, and glue in the same, it will pay to do it.

WM. NEWTON.

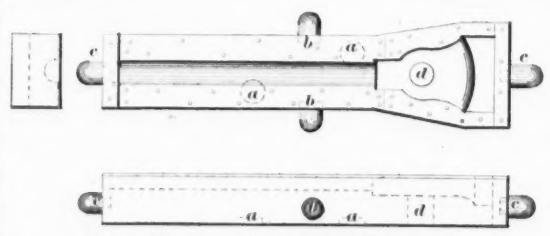
Why Are Gears Noisy?

Editor American Machinist:

In continuing the subject of noisy gearing, I would say the following questions are often asked: Which is the better running gear—the involute or the epicycloidal—at a fixed center distance? Which retains its shape the longer, and which is the stronger? In running at a fixed center distance, which will make the least noise—two or three gears? Which will be the quieter—the gear having its teeth stoned and polished, or the gear that is left just as it comes from the planer?

I will endeavor to state what my experience has shown, in answer to the above questions, and hope that some of the professional gear men will do likewise.

In answer to the first question, would say if the teeth in an epicycloidal gear conform exactly to the correct curve when rolled out, the teeth will bear as hard at the points as at any other part, and, as stated in my previous letter, this will produce a noise, but, at the same time, make fair running gears. A perfect and still-running gear must bear slightly at the points, and continually harder towards the pitch line. That is one of the advantages of the involute over the epicycloidal form.



CORE BOX FOR DRAW-BAR PATTERN.

Now I think if the majority of machines were closely inspected, the center distances of the gears would not be found exactly correct; they might be .005" to .020" too far apart, and epicycloidal gears run on these machines would prove very noisy indeed, while if involute gears were placed on the same machines, the difference would be apparent at once, as they would make but very little noise, the gears in each case being made of the correct curve for the exact number of teeth. This is one more advantage of the involute over the epicycloidal.

I have often heard it said, and by practical men, that, no matter what curve a gear tooth is made, it will always wear epicycloidal. Now I think this quite wrong, and claim that if the involute curve, as we call it, is properly made, it will always wear involute, and the same may be said about epicycloidal.

It is my experience that if involute gears of say 4 P 80 and 22 T are made of the correct curve for the right number of teeth, and run about 400 revolutions per minute, with a fair amount of work to do for eight hours per day, they will run for six years, and still be fair running gears, and comparatively quiet. I have seen epicycloidal gears that under the same conditions could be heard more than 70 feet away.

In regard to the strength of the teeth of involute and epicycloidal gears, the involute is the stronger by far, which is another advantage over the epicycloidal.

Regarding the question, which will run the quieter at a fixed center distance—two or three gears carrying the same load—I consider two gears, as there will be less friction, consequently less noise. If three gears are used, and the pitch made finer, the load may prove too heavy. Good judgment should be used in selecting the proper pitch to perform a certain amount of work, as gears of too small pitches are too often imposed upon, and, the load being too great, the teeth lose their shape, and become noisy.

In regard to gears with teeth stoned and polished, would say I claim that the gear with teeth left just as they come from the machine will run the quieter, for the reason that, when a small amount of oil is put on, it fills all the small pores, and will keep the gears lubricated for a considerable length of time, while if oil is put on the teeth which are stoned and brightly polished, these teeth will become perfectly dry in a very little while.

In conclusion, would say I hope we shall hear from "Jarno" in particular, as I think he can furnish much valuable and interesting matter as the result of his investigations.

A PALE-FACE WORKMAN AT THE BENCH.

Impostors as Inventors.

Editor American Machinist:

Mr. A. D. Pentz, in the *Engineering Magazine*, gives an interesting sketch of Mr. Scobber as an inventor. Condensed, it is about as follows: After being manager of a business for some years, Mr. Scobber concluded that some improvements might be made, so inaugurated an experimental department, and put a young machinist in charge. Mr. Scobber had not been suspected by his most intimate associates as possessing any inventive ability, yet in about a year some valuable improvements had been made, and he had obtained his first patents. Then followed a series of patents that gave Mr. Scobber a high rank as inventor, placed the goods he was manufacturing far in advance of those made by his competitors, and secured for him an interest in the firm for which he was working. The prosperity of Mr. Scobber seems to have roused the envy of the young machinist, who became difficult to manage, and who even went so far as to claim that he had made the inventions patented by Mr. Scobber. Finding it impossible to soothe him they were forced to discharge him. Evidently disgusted by the whole proceeding Mr. Scobber ceased entirely to make inventions, and has not since appeared in the records of the Patent Office, though he is still in the prime of his life, and still holds his position as manager of the business. The young mechanic has since become a celebrated electrician.

Somewhat different, yet equally successful from a financial point of view, was the inventive career of Mr. Roundrell. Like Mr. Scobber, Mr. Roundrell had not been known as of an inventive turn of mind, but he had been engaged for a number of years in one of our large cities as the local agent for a machine of general household utility, and had acquired a good deal of ability as a persuasive talker. He had noticed and been somewhat envious of the success of other parties in making improvements on other machines, and he had a desire to do something of this kind, if opportunity should offer.

One day one of his customers wished his machine would perform certain operations. He thought it possible that this might be done, but he really had no idea how to go about it. After several days of thought, he hunted up a model maker, explained what he wanted, and asked him if he could make

a rigging to accomplish the end. In due course of time he received a somewhat rude, yet in a certain sense effective device for the purpose. He immediately applied for a patent, and, showing the device privately to some friends, soon obtained a reputation among the unskillful as an inventor who was soon to make his fortune. Believing that he saw an opportunity ahead of him, he resurrected the old suggestions of other customers, and employed the model maker to carry them out, applying for patents as soon as they were constructed.

Having obtained these, he used his acquaintance and ability as a persuasive talker to organize a stock company, taking some money and a good-sized block of stock for his inventions, and getting himself appointed manager at a good fat salary. A shop was soon started, and in about a year the first machines were turned out, which proved failures. A meeting of the stockholders was held, at which Mr. Roundrell was careful to have a good dinner, with a fair supply of the best champagne. He explained that the highly recommended foreman had permitted poor workmanship that spoiled the whole business. He also gave glowing accounts of the opinions of experts, and the demand he had been working up for the machine. He secured a liberal appropriation, hired a new foreman, and started a new lot of machines. This time Mr. Roundrell had the sense to employ a draftsman, and the machines were less pronounced as failures, though far from being what was represented. Another meeting, with its dinner, champagne and explanation, was held, and another appropriation secured. Before the new machines were completed a quarrel occurred that enabled Mr. Roundrell to sell out for a good sum. He now owns two or three business blocks, and deals in real estate. The shop stands idle, and the machinery is accumulating rust and antiquity.

The Scobbers and Roundrells are by no means scarce, and any person with fair intelligence, good presence, and a smooth tongue, can play the part of either, provided his conscience is somewhat elastic. Mechanical knowledge or inventive ability is not a requisite, but rather a detriment to acquiring a reputation as an inventor in this way. All that is necessary is to employ some mechanic to carry out some other fellow's suggestion, and you are an inventor, provided you pay the mechanic, or induce some one else to pay him, for his time. I have held one end of this string several times, and am likely to hold it several times more if I live. I have also had occasion to test the question of inventorship, and have found that the Commissioner of Patents holds it to be at the place designated.

A case within my personal knowledge is as follows: A. made a suggestion of a certain machine in the presence of B. B. took up the suggestion and made sketches of a machine that afterwards proved to be almost identical with that shown in an ancient patent. B. then employed C. to help out and make drawings. The drawings made by C. differed wholly from the sketches of B. and from any previous machine. D. paid the bills for drawings and construction. Held: B. was the inventor, presumably because he did the running and claimed to be such. As D. furnished the money to pay all of the bills, as well as for the individual support of B., it is hard to see why he, instead of B., should not be called the inventor.

In another case E. made a machine for dropping a coin in the slot and obtaining some liquid refreshment. F. saw the machine, and attempted to make a simpler one. After making a number of models, all of which were failures, F. was induced to consult G. G. made a drawing supplying the device that made the difference between success and failure. As inventor, F. then obtained a patent and organized a company for $1,500,000. For a while, at least, F. was living on the fat of the land.

In still another case, H. was employed using a machine built and owned by J. H. conceived that he might make a more effective machine in another way. The machine was all right except that there was one obstacle which neither he nor the draftsman could overcome, and which, unless it was overcome, made the machine worthless. K. made the device that surmounted the difficulty. H. obtained a patent for this device, and is now making a good living out of its use.

Incidents like this might be multiplied, but it is needless. Similar cases are so notoriously common, that I can only wonder where "A Mechanic" can have been to say that he never heard of an impostor inventor who ever made a cent. I think the general verdict is likely to be that there are more real inventors who never made a cent than there are impostors in a like fix.

C. L. REDFIELD.

Flush Boiler Fronts.

Editor American Machinist:

I think if Mr. T. T. Parker will investigate the flush front boiler setting a little further, he will not need an extra bump on his cranium to demonstrate the fact that, as usually constructed, the whole length of boiler shell is available as heating surface, while with the overhanging front the thickness of the front lining, generally 13", has to be deducted from the length of boiler shell.

I think with him that the head should be flanged in, and would say that it has been everal years since I have seen one otherwise.

ALONZO G. COLLINS.

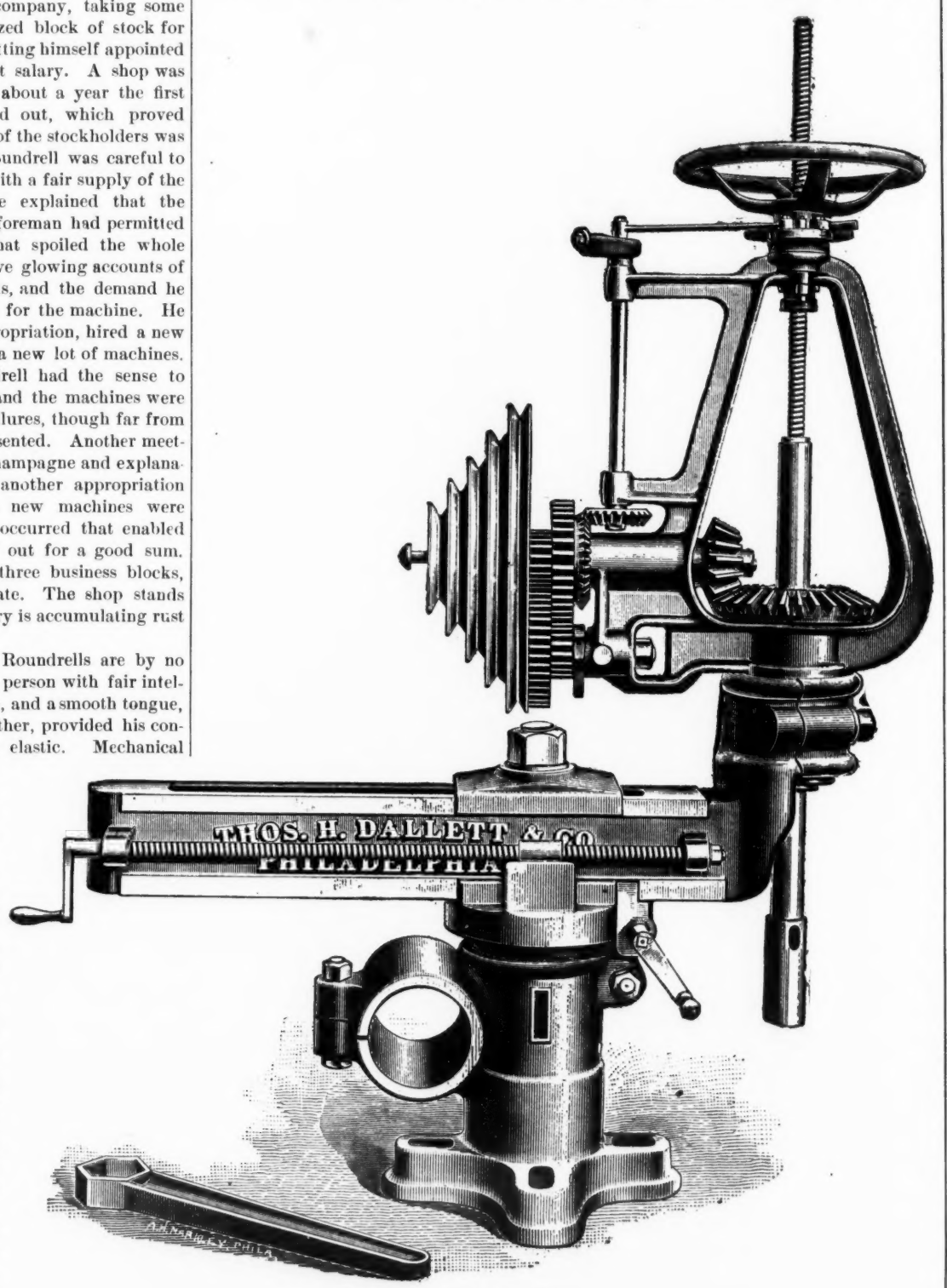
Printing by Electricity.

Editor American Machinist:

I note in your issue of September 29th an article reprinted from the *Pall Mall Gazette*, entitled "Newspaper Printing by Electricity," in which occurs the following sentence, in regard to the *Birmingham Daily Gazette*: "The *Gazette* is absolutely the first daily paper in the world that has been produced by that form of power which bids fair to revolutionize the whole system of machines, and leave steam and even gas far behind as motive forces." The date of this remarkable statement is not given, but assuming that your quotation is from a recent issue, the alleged enterprise of the proprietors of the paper mentioned must be extremely amusing to any of your readers who have kept posted in the progress of the science of electric power transmission in the United States during the past few years. As early as 1888 the writer had installed at least a dozen electric motors in New England newspaper printing establishments, a fair proportion of which were used in printing daily editions, and, were it worth while to go into details, considerable of your valuable space could be taken in enumerating well-known papers whose presses are to-day run entirely by electric power.

In no captious spirit, but with a desire that American enterprise receive due credit, the above statement is made, in the hope that it will receive due acknowledgment at the hands of your exchange.

H. C. SPAULDING, *Electrical Engineer.*
Exeter, N. H.



A LARGE PORTABLE DRILL.

Investigation of Twenty-one-foot Precision Screw.

Editor American Machinist:

In an item in which you refer to a paper of mine concerning an investigation of a screw made by Pratt & Whitney for R. Hoe & Co. there is one omission which needs to be rectified. The screw has a length of 21 feet, and when it is stated that the total error was less than one-hundredth of an inch the addition should be made that this was the total correction for a length of 17 feet.

Waterville, Me. WM. ROGERS.

[Professor Rogers here refers to that part of our report of the "Proceedings of the Mechanical Section of the American Association for the Advancement of Science" which appeared in our issue of October 20.—ED.]

A Large Portable Drill.

The accompanying illustration is of a portable drilling and boring machine which is much larger and heavier and is intended for a much larger range of work than is usually the case with such machines. The weight of this machine is 900 pounds, and it is capable of boring with a bar a hole 20" diameter, the spindle having a traverse of 22" and the arm a reach of 36".

The construction of the machine will be readily understood from the engraving, which shows that there is a post having four radial slotted arms at the foot, by which it is bolted to the work or machine which is to be operated upon. The top of this post is bored to receive a cylindrical piece the top of which is adapted to receive and hold the arm, which is moved through it by the traversing screw seen, and is rotated in a horizontal plane by means of a worm and wheel, the handle of which is seen at the right of the post. This piece also fits into a socket bored for it at the side of the post, and when placed in this the drill spindle can be fixed at any desired angle to the surface upon which the machine is bolted. The frame of the drill proper can be swung in the end of the arm and clamped in such position as to be most convenient for arranging the belt, which is round and runs on a five-stepped cone pulley, from which the transmission is through gearing giving ample driving power. An automatic feed is provided, as shown, which has a range from .005" to .125" per revolution of the spindle.

This machine has been used with great success in boring holes in the frames of dynamos and other machines, and also for cutting flue holes in the heads of large boilers. It is made by Thos. H. Dallett & Co., Philadelphia, Pa.

A recent dispatch from Greensburg, Pa., says: "New life has been infused into the natural gas business in the famous Murraysville region, the original source of supply for Pittsburgh. Duff Brothers, of Pittsburgh, who have been drilling a well on the Cline Farm near Manordale, have struck an immense pressure of gas in the fifth sand, 2,240 feet below the surface, or about 400 feet below the original Murraysville sand, which supplied Pittsburgh for years. The well shows a pressure of 500 pounds a minute, and when properly tested will be increased to 600, and possibly 700 pounds. The well is located about midway between Murraysville and Grapeville. The sand is 35 feet thick. Prominent gas men say this will open up a new field and will insure plenty of gas for years."

There is considerable excitement here over the discovery.

The standard length of rails on the railways in India is 35 feet.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
203 BROADWAY, NEW YORK.

PUBLISHED WEEKLY AT
203 Broadway, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

Subscription.

$3.00 a year in advance, postage prepaid, in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Buffalo News Co., Buffalo, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, New York.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.
The Wisconsin News Company, Milwaukee, Wis.

The International News Company,
BREAM'S BLDG'S, Chancery Lane, LONDON, E. C., ENG., or Stefanstrasse 18, LEIPZIG, GERMANY, will receive subscriptions for the AMERICAN MACHINIST, at 16/6 per annum, English currency, or 17 marks per annum, German currency, postpaid.

Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 20 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, NOVEMBER 17, 1892.

CONTENTS.

	PAGE.
Machinery Hall at Chicago	1, 2
Economy of Machine Shops for Electric Street Railways. By John F. Bickford	3, 4
On the Cultivation of the Inventive Faculty by the Solution of Constructive Problems. By Leicester Allen	4, 5
Letters from Practical Men: Bursting of Emery Wheels and Boilers. By W. H. Booth....A Case of Friction Gearing. By Superannuated .. Core Box for Draw-bar Pattern. By Wm. Newton ...Why Are Gears Noisy? By A Pale-face Workman at the Bench....Impostors as Inventors. By C. L. Redfield .. Flush Boiler Fronts. By Alonzo G. Collins .. Printing by Electricity. By H. C. Spaulding....Investigation of Twenty-one-foot Precision Screw. By Wm. Rogers	5, 6, 7
A Large Portable Drill	7
Profit Sharing	8
As to Motives Behind the Efforts for Improved Roads	8
The Steamers of the World.	8
Literary Notes.	8, 9
Questions and Answers.	9
Profit Sharing	9, 10
Manufactures	10
Machinists' Supplies and Iron	11

Profit Sharing.

We publish in another part of this issue an article written by Mr. N. O. Nelson, of St. Louis, in which he makes some comparisons between the sliding scale system of paying wages, and profit sharing. With the latter system Mr. Nelson has had considerable experience, since he is at the head of an industrial establishment in which profit sharing has been practiced for some time, the results, so far, having been very gratifying to the workmen, to the proprietors, and to those generally who believe in profit sharing, and hope that it may prove an important agency in removing many of the present causes of friction between employer and employed.

The principal points which Mr. Nelson makes against the sliding scale are that: The amounts paid to the workmen are dependent upon something which they cannot control, *i. e.*, upon the selling price of the thing manufactured. That the entire amounts due the workmen are paid in full at short intervals, and are, therefore, spent by the men as they go, and finally, that it applies to but few men out of the total number employed.

As to the first objection mentioned, it certainly seems that profit sharing has decidedly the advantage; for, in profit sharing, the dividends depend not solely upon selling price of products over which the workmen have no control, but largely upon the efficiency of the particular establishment in which they are employed, upon which efficiency they can exercise a very great influence when so minded. This, it seems to us, is the most vital difference between the two systems, the other points mentioned not seeming to have so much application to the discussion, for the simple reason that the features involved in them do not seem to be necessary parts of one system more than of the other. The premiums resulting from a market price of goods above a fixed minimum may be retained until the end of the year, as well as those resulting from a combination of high selling prices and high efficiency of plant; and even if this were not so it is doubtful if the saving of profits or dividends to the end of the year would have any very great influence upon savings, for those who are naturally improvident will usually anticipate an expected revenue and devise a dozen different ways of spending the money before its payment is due, whether they be workmen or not, to say nothing of the fact that employers are in no way responsible for the saving of money by employes or the teaching to them of habits of economy, any more than workmen are in duty bound to teach employers to economize and save their money. As to the point that the sliding scale applies to only a few men, and those the highest paid ones, this does not seem to be necessarily the case with the sliding scale at all, but is nothing more than a criticism which can be applied to the particular establishment to which Mr. Nelson refers, because no good reason can be imagined why the wages of the humblest laborers in an industrial establishment should not vary with the selling price of product as well as those of the most skillful and highest paid mechanics. It must be conceded, however, that Mr. Nelson shows the superiority of profit sharing over the sliding scale, and his article is well worth the reading.

As we have before intimated, however, we do not think that in profit sharing will be found the solution to the labor problem. Profit sharing is a good thing as far as it goes or can go, and is a good thing for those who adopt it so long as its adoption is not universal. But the prices at which competitive work is done in machine shops, for instance, is in the main governed by the ascertained efficiency of the shops competing for the work, and any cause which brings about an increased efficiency, whether it be profit sharing or any other, will help mainly those who are first to take advantage of it; its universal adoption resulting only in a renewal of competition on even terms—a competition which inevitably affects the rate of wages. This, however, does not do away with the fact that by profit sharing, more than in any other way, perhaps, when fairly managed, employer and employed are brought together in a common interest and almost forced to look at both sides of questions affecting those common interests, and this habit of mutual conference will undoubtedly be beneficial to both.

As to Motives Behind the Efforts for Improved Roads.

Several times we have had something to say regarding the movement for good roads and of the prominent part that Col. Albert A. Pope, of Boston, has been and is taking in this movement. Referring to one of the most recently published items concerning this, a friend writes that "Better roads make a bigger field for the sale of bicycles, including the Columbia bicycle, which is made by the company of which Col. Pope is president. See?" We do see, and have been seeing from the start. One of our earliest references to the subject took note of the fact that Col. Pope was not acting in this matter from disinterested motives solely; but that does not do away with the fact that improved roads is one of the greatest needs of this country at the present time, and will be of incalculable benefit in building it up and increasing the pleasure of living in it. As has been well said by a contemporary, "Wagon roads are as much feeders of railroads as are logging or mining roads." In fact, they are even more so, for the same reason that white sheep are said to eat more than black ones—because there are more of them. It is thus evident that the condition of wagon roads is important to railroads, and has a direct influence upon their business, and if it is important to railroads it is important to every man, woman and child in the country, and Col. Pope is entitled to credit and to help in his efforts in this direction, whether the proposed improvement results in more business for his bicycle factory or not.

We are constantly publishing illustrations of new machines and giving the credit of their production to their designers and builders. We do this without charge or consideration of any kind, and simply because we think our readers are interested in knowing about new machines as they are brought out. Such publication is unavoidably an advertisement for the producers of the machines, but should that fact prevent our publishing things our readers are interested in knowing?

By the way, the latest move of Col. Pope is to get up blank petitions to Congress asking it to take certain action favorable to improved roads. These petitions are sent to any one interested, for signatures, and may be obtained by addressing Albert A. Pope, P. O. Box B., Boston, Mass. This may be another advertisement, but we can't help it if it is; we believe thoroughly in the movement for improved roads, and that we are doing a public service by helping it along, and that is sufficient justification.

The Steamers of the World.

The new list of the merchant marine compiled by the Bureau Veritas, which is now in press, gives some interesting statistics concerning the great ocean steamship companies of the world.

Some people will be surprised to learn that the transatlantic lines are not the leading ones in aggregate tonnage or number of vessels. The British India of Glasgow and the British India Steam Navigation Company and the British India Associated Steamers, all one concern, head the list with 103 steamships. Their aggregate measurement is 239,635 tons.

Next stands the Peninsular and Oriental Steamship Company, with 36 steamships, representing 216,887 tons. Next in order comes the Compagnie des Messageries Maritimes, with 61 vessels, whose aggregate tonnage is 202,522. The fourth on the list is the Norddeutscher Lloyd of Bremen, some of whose vessels ply to this port. This company has 66 steamers, measuring in all 197,169 tons.

Other important lines are the Navigazione Generale Italiana, 106 steamers, 170,755 tons; the Compagnie Générale Transatlantique, 66 steamers, 167,487 tons; the Hamburg-American Packet Company, 56 steamers, 165,442 tons; the Wilson Line, 86 steamers, 158,089 tons; the Austrian Lloyd, 73 steamers, 128,359 tons; the Allan Line, 39 steamers, 123,038 tons; the Spanish Compania Transatlantica, 34 steamers, 94,163 tons; the White Star, 20 steamers, 95,370 tons, and the Cunard, 26 steamers, 85,913 tons.

It seems to be demonstrated that a recent severe and fatal accident which occurred on an English railway was due to the downright inhumanity of the representative of the company in compelling a signalman who was physically and mentally worn out by watching at the bedside of his dying child to go on duty as usual, notwithstanding the signalman protested and gave warning that he was unfit for duty. If this report is true, as we have no reason to suppose it is not, then we think no penalty can be too severe for the officer or officers responsible for such a brutal outrage. A man who is compelled, on pain of losing his position, to serve in such a capacity, or in any capacity, while utterly unnerved by the sickness and death of a child whose body yet lies at home, is outraged, and we hope public opinion in England will be so roused by this incident that such a thing cannot occur again. If so, then the people who were killed in the wreck will at least not have died entirely in vain. The accident shows that at least some concession must be made to the limitations of human powers and of human nature, from purely selfish motives if humane motives fail.

The card of a mechanical engineer, which lies before us, naturally raises the question as to what constitutes a specialist. The list of "specialties" of this engineer includes nearly if not quite all the science of mechanical engineering, while a specialist is supposed to be specially posted in, and to devote special attention to, some particular line of work, and when he makes a specialty of the whole field of his profession he ceases to be a specialist, no matter how much he may know of it all. It is not so much a question of how much a man may know of any profession as of the exact meaning of the term "specialist."

The Illinois Central Railroad Co. has issued a book entitled, "Where to Locate New Factories." It gives particulars regarding the advantages of the various towns reached by the Southern Division of this road.

Those who are looking for localities in which to establish new industries will probably find this book useful and suggestive. It may be obtained by addressing A. H. Hanson, General Passenger Agent, Chicago, Ill.

What may turn out to be one of the most oppressive and obstructing monopolies in the country has recently been started by the combination of the Colorado Coal and Iron Co. with the Colorado Fuel Co., the combination to be known as the Colorado Fuel and Iron Co. The first-mentioned company has long maintained a practical monopoly of the coal and iron business of that section.

A correspondent asks that practical men give their views as to estimating on machine work. He thinks many foremen would be interested.

Mr. William Kent, consulting engineer, has removed to room 22, 35 Warren street, New York.

Literary Notes.

EMPLOYER AND EMPLOYED.—This is the name of a new quarterly publication which is published for the Association for the Promotion of Profit Sharing, by George H. Ellis, 141 Franklin street, Boston. This journal will, of course, be avowedly the organ of the above-mentioned society, but in being its organ will do what the members of

it believe to be the best that can be done to bring about a better understanding between employer and employed. It is not, however, confined, nor is the society confined strictly to profit sharing, but favors any means by which employes may be given an interest in the business with which they are connected, beyond their daily wage. Those who wish to keep posted as to what is being done in the world on the lines indicated, will, of course, find this publication a very great help. Its cost is 10 cents a number, or 40 cents a year.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(486) P. G., Limestone, N. Y., writes: Referring to the article on "Pattern Modeling," in your issue of April 14, current volume, what kind of fats should be used in making modeling clay? *A.*—The fats mentioned are of the glycerine kind.

(487) G. P. D., Vina, Cal., writes: Please inform me of the dates of your issues containing articles relating to ice machines. I think it was in 1890, but I have lost the papers, and I wish to secure other copies. If you can furnish them, please state the price. *A.*—May 29, June 5, 26, July 10, August 14, 1890, and May 28, 1891. We can furnish these at 6 cents per copy.

(488) Subscriber, ——, Ill., writes: Please inform me if white lead, lampblack and Prussian blue will make the correct steel color paint; and if so, how much of each color should be taken? *A.*—That depends much on the shade you prefer. After you have made your selection, let the painter make his own mixture to conform with your choice.

(489) F. A. T., Long Island City, N. Y., writes: Kindly give the ratio between the average force obtained by the best screw propellers and the amount of power that must be expended. *A.*—This is a subject on which engineers do not agree. We should advise you to consult A. E. Seaton's Manual of Marine Engineering, in which this subject is discussed.

(490) I. L. D., Woodstown, N. J., writes: Please inform me what kind of paper is used for Patent Office drawings, the name of the paper, and where I can get it. I have looked a good deal in Philadelphia, but cannot find what I want. *A.*—Ask for Patent Office bristol board. Nearly all dealers in drawing materials keep it. We know that it can be bought at Keuffel & Esser Co., Fulton street, New York.

(491) W. H. W., Newark, N. J., writes: Please inform a poor man the cheapest way he can secure a new invention, so that he can show it to other persons with a view of interesting them in the manufacture of it without the risk of losing two years of study and experimenting. Your answer will be thankfully received by many. *A.*—We see no other way than to engage the services of a reliable and honorable patent solicitor, of which there are many, to secure the patent for you. After that you need to have no anxiety in showing the invention to others.

(492) N. G., ——, asks: In your issue of July 28 you illustrate a riveting machine as a new thing. Now I want to know if manufacturers of light sheet metal goods have not been using power presses to set rivets for a long time? *A.*—They have been using power presses for a long time for this purpose, but not that particular press and arrangement. Machinists have used for a long time lathes for turning iron, but nevertheless we occasionally illustrate an entirely new lathe. 2. Did you not illustrate a belt helve hammer a few years ago for just such work? *A.*—In our issue of September 26, 1889, such a hammer was illustrated.

(493) L., Little Falls, N. Y., writes: Please inform me through your columns for what purpose aluminum is used, and at what price it can be bought. *A.*—It may be used for a vast variety of purposes; in fact, its comparatively high price at present limits its use to some extent. It is not expected that it ever will replace iron or steel as a structural metal, but it may replace German silver, copper, tin and zinc for some of the purposes for which these metals are used, but by no means for all. It is too high priced for table ware, but is excellent for moderate priced wire. It will probably make a better roof than copper, tin or zinc, if it is ever as cheap as these metals. It is frequently used for castings made for decorative purposes; in fact, its field of usefulness is exceedingly great. The price at present is about 65 cents and upwards, according to quality and quantity, per pound.

(494) F. M. B., Boston, Mass., writes: Please decide an argument in relation to a piston valve with Marshall radial valve gear and a piston valve with link motion. Which will give the best results in a 3 inch cylinder with an initial steam pressure of 150 pounds per square inch? *A.*—With the Marshall valve gear a large variation in the amount of cut-off is possible without wire-drawing from small opening and slow closing of the port, as is the case with the common link motion; but for so small an engine as referred to there will be no difference of any practical importance in the results by the use of either valve gear. We prefer the ordinary link motion for small engines; in fact, when the steam chest is placed in the ordinary position, that is, its center line lying in the same plane with that of the crankshaft, the ordinary link motion is the most suitable one.

(495) L. E. M., Syracuse, N. Y., writes: I have two blanks to thread, each 3" diameter. One I thread 1" pitch single square thread and the other 1" pitch double square thread. With leverage, fitting of nuts, lubrication, etc., the same in each case, which screw will raise a weight of 100 pounds with the least power applied? Would there be any difference, and if so, how much, with a 24" lever? By pitch I mean the distance a nut would move in one revolution. *A.*—With either of these screws 100 inch-pounds of work is to be done at a revolution, and as the force applied travels through the same distance in each case, the same force will be required to do the work if the question of comparative efficiency of the screws is not considered, and for the conditions named the efficiency of the screws, *i. e.*, the proportion of the applied power wasted in friction, will be practically alike.

(496) J. P., Dayton, Ky., writes: Please give me information on cutting a screw $1\frac{9}{32}$ to the inch on a lathe with a lead screw 5 threads per inch, with the following list of gears to choose from: 20, 25, 40, 50, 55, 60, 65, 70, 72, 80, 120. *A.*—Supposing the lathe to be simple geared, you cannot cut such a thread with the given gears. Gear 80 on stud and 20 on the screw will give $1\frac{1}{4}$ threads per inch, which is within $\frac{1}{32}$ of a thread of the right number; 160 on the stud and 41 on the screw would give the proper pitch. All such problems may be easily investigated by simply reducing the pitch of the lead screw and of the thread to be cut to fractions having a common denominator. In this instance, $1\frac{9}{32} = \frac{41}{32}$ and $5 = \frac{160}{32}$, which shows that the two threads are in the proportion of 41 to 160, and gears having that number of teeth, or any others in the same proportion to each other, will cut the desired thread, 41 and 160 being the smallest pair in this instance, because 41 is not divisible without a remainder.

(497) A. J. P., Elmira, N. Y., writes: Can you give me any information regarding black dyeing, such as is done on spools, etc., and black enameling such as is done on wood handles, etc.? If you can give me the process in detail I will most willingly pay you for your trouble; if you cannot do this, answer through your columns. Do you know of any work that treats on this subject? *A.*—These questions are somewhat out of our line. We do not know the best process for dyeing wood. For black enamel for wood we find the following; Prime the wood with linseed oil, turpentine and white lead; then give it two or three coats of black, mixed with copal varnish and turpentine. Rub it down when dry with pumice stone and water; finally varnish with copal; again rub down and polish with oil and rotten stone to obtain a perfect smoothness. We do not know of any work which treats on this subject. The above receipt was taken from the "Scientific American Cyclopedia of Receipts, Notes and Queries," a very useful book to have. We do not accept any remuneration for any information we may be able to give.

(498) A. W. W., Westfield, Mass., writes: Can you inform me whether pure aluminum can be hardened or not? *A.*—It can be hardened to some extent only by hammering, rolling or working. 2. Has it any temper? *A.*—No. 3 What are its wearing qualities and strength, compared with brass? *A.*—Pure aluminum under ordinary circumstances withstands the action of wind and weather exceedingly well, and in this respect compares well with brass; for shaft bearings it is too soft and is not as good as brass; but a small percentage of aluminum added to Babbitt metal gives superior results, increasing the durability and wearing property of the alloy. As to strength, it is not as strong as has been widely claimed; it is only about as strong under tensile stress, section for section, as cast-iron, and has less than one-half the strength of wrought iron under ordinary conditions. Under compression, the metal has a very low elastic limit, although its extreme ductility allows the metal to flow on itself so freely as to make it, for special purposes, a very safe metal to use in compression. It is not a rigid metal, and bends under transverse forces very readily. Generally, the purer the aluminum, the softer and less rigid it is.

(499) G. W. M., Baltimore, Md., writes: I am 19 years of age, with a common school education. I have the desire to follow the art of mechanical drawing. I understand free hand drawing pretty well. Kindly inform me whether by attending a drawing school, and advance myself further in the study of algebra and arithmetic, I would have the proper qualifications for entering the drawing room; or, must I serve a term in the machine shop as an apprentice? *A.*—In order for any one to become a first-class draftsman, he should have practical experience, and we believe that this can be best obtained by working as an apprentice in the machine shop. We should, therefore, advise you to start working in the machine shop. Although this course may not be absolutely necessary, we believe it to be the best one, and it will give you the opportunity of devoting your evenings to study. A knowledge of drawing is, of course, one of the necessary qualifications for entering the drawing room, and this, with the addition of a knowledge of arithmetic, geometry and algebra, are the necessary qualifications for learning the profession. If you observe closely the best methods for doing work in the shop, and use your best efforts for advancing yourself, and in the meantime devote your leisure time to study, you will undoubtedly have, at the close of your apprenticeship, all the necessary qualifications for entering the drawing room, and start you on a successful career.

(500) W. H., Peterborough, Can., writes: We inclose a blue print of a steel marine boiler of the so-called Scotch type, which we made some time ago for a firm in British Columbia. It was built to stand a working pressure of 120 pounds per square inch, and on which we got 123 pounds by the steamboat inspectors. The boiler was placed in the boat, the feed pipe was attached to the front end, and water taken from the surface condenser. About five months after the boiler was placed in the boat it got burnt about the center of the back head of the combustion chamber, and leaked at the stay bolts, and the steel got wavy. We think that this is due to oil finding its way from the condenser into the boiler. What we would like to know is what action does oil have upon the boiler plates when the heat or flame impinges upon it? *A.*—Your drawing shows a very good design of boiler, and one built according to it should give, when carefully worked, no such trouble as you speak of. The presence of oil in the water tends to form a pasty sludge with the impurities in the water; this sludge adheres to the sheets and may be the cause of overheating; but with pure water, such as is obtained from a surface condenser, there is very little danger of the formation of a pasty matter on the sheets, particularly on one placed vertically like the back head of the combustion chamber in your boiler. It is possible, but not at all probable, that the sheet has been covered with a sticky matter and caused overheating; if so, an examination of the boiler will reveal the fact. If the sheet is burnt it is probably due to a poor quality of material; but we are rather inclined to believe that the sheet is not burnt, and that, through the carelessness of a workman, some of the stay bolts have not been properly screwed into the sheet, thereby throwing an excessive stress on others, which, with the unequal expansion of the sheets, caused these to break and allowed the sheet to take the wavy form. The cause of the trouble can be discovered only by a careful examination of the boiler.

(501) W. D. O., Boston, Mass., writes: I come again to you for light on a subject which I cannot understand. I am trying to prepare for an examination in the revenue service, and have been studying up on the condenser and calculations for determining the loss by blowing off water, and the gain by heating. I also inclose a sheet containing the formulas, but I am so tangled up with the brackets, etc., that I cannot reduce them into plain English. Will you be kind enough to help me over this stumbling-block? Also explain the following formula:

$$L = 966 - 0.7\ (T - 212).$$

First: How is the decimal .7 obtained? And how is it applied to $(T - 212)$? I have tried to have it explained to me by old engineers, but they got mixed up too. *A.*—You do not state what the letters L and T denote, but we recognize the formula to be one deduced from Regnault's experiments, which gives approximately the latent heat of steam produced at a given temperature (Fahr.) above 212 degrees. In this formula L denotes the latent heat of steam in units per pound, and T the temperature of evaporation on Fahrenheit scale. The quantity 966 denotes approximately the number of units in the latent heat of steam at 212 Fahr. The decimal fraction .7 is determined by experiment, and this, as well as 966, are constants in calculations of this character. The decimal .7 being placed before the quantity in the brackets denotes that the quantity in the brackets must be multiplied by the decimal. Thus: Suppose it is required to find the units of latent heat in a pound of steam at a temperature of 326 degrees Fahr. Here L denotes the number of units to be found, and T denotes the given temperature of the steam; substituting this value of T in the formula we have

$$\begin{aligned} L &= 966 - .7\ (326 - 212) \\ &= 966 - .7 \times 114 \\ &= 966 - 79.8 = 886.2 \end{aligned}$$

units of heat in the latent heat of steam at a temperature of 326 degrees. This, of course, is only a close approximation, near enough for many practical purposes. As to the other formulas, state what the letters denote, or, better still, give us the name of the book from which the formulas have been taken, and we shall take pleasure in helping you.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Prices greatly reduced. See Grant. Page 20.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

$10 Countershafts. A. D. Pentz, Elizabeth, N. J.

Tool Holder: Armstrong Bros. Tool Co., Chicago.

New lists of cutters. Brown & Sharpe.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Drill Presses, with Tapping Attachments. Gould & Eberhardt, Newark, N. J.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Standard Tool Co.'s Twist Drills.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

For Pattern Shop Supplies. Send to The D. C. & F. Co., Richmond, Ind., for Samples.

Castings for small and medium-sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

"Shapers (Double Triple Quick Stroke")
Trade Mark.
Gould & Eberhardt, Newark, N. J.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., cor. Canal and Washington Sts., Chicago, Ill.

Patterson, Gottfried & Hunter, Limited, 146-150 Centre st., New York, are putting on the market a new alarm speed indicator. Send for circulars.

Gear Cutters, Auto. Specially adapted for Motor Gears.
Gould & Eberhardt, Newark, N. J.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide. S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Profit Sharing.

Had Mr. Carnegie adopted profit sharing instead of the sliding scale, the chances are there would have been no Homestead massacre, and the stoppage of work throughout the country incidental to the strike would have been avoided. Mr. Carnegie adopted the sliding scale plan, with profit sharing in mind. He was, at the time, greatly interested in the relation between master and men in all its bearings. He triumphantly eulogized American democracy, American protection, labor unions, arbitration, and co-operation, which is profit sharing carried to its ultimate conclusion. He not only ventured to hope that complete co-operation would become the industrial system of the future, but, in declaring the proprietor's wealth to be a trust fund, he called upon

public sentiment to make it a "disgrace to die rich." The gentle aroma of socialism in all this was more startling then than now. Except for Mr. Carnegie's well-known money making powers, his four-in-hand coaching tours, and his Scotch head, these declarations might have been set down to a sympathetic familiarity with Plato or More or Godin. The motive in adopting the sliding scale was good enough. He meant to pay larger wages when he got larger prices. There was a bed-rock of selling price and a bed-rock of wages. More price, more pay. Here is the nub. The plan is wages, pure and simple; but the amount of the wages varies according to the market price of the product. It embodies no element of profit sharing. The increase of wages is due to causes upon which the workman has no influence whatever. Whether he or his fellows do well or ill, work carefully or slovenly, rapidly or slowly, it has no effect on the tonnage rate paid him. As he is paid by weight, these differences affect the amount he will receive; but they do so no more under the sliding scale than under any piece work system. As to the general results, the actual profits of the business, the workman has no interest. As to his own output, the slight increase in the rate per ton could have no effect on the character of his work. A piece-work man works his hardest, and he cannot be speeded up by adding two cents or five cents to the dollar of schedule.

One essential of profit sharing is that the earner's share is saved up. He does not get it day by day. The most serious evil that surrounds the wages system is the facility afforded for spending every copper that is earned. A wage-earner is relieved of all responsibility outside of the particular work which is provided for him. He can rent a house, and buy furniture on the installment plan, or rent it at 5 per cent. a month. He can supply every want that his week's wages will cover, and a little more, by paying high prices for credit purchases. He can buy every variety of amusement. He gets his pay every Saturday night; and, with all their worldly possessions in their pockets, it will be none but exceptional men who will of their own voluntary determination hunt up a place in which to lay by money which it is so convenient and so agreeable to spend at once. Profit sharing hoards up till the end of the year, and it then offers some tangible and attractive plan of investment. There is nothing of this in the sliding scale. It is higher wages, but still only wages—to be spent as wages are.

The sliding scale applies to but a small fraction of the whole force, usually not more than five to eight in a hundred Those who benefit by it are only the skilled men; those who manipulate the expert processes are highly paid. The mass of the workers are excluded. There is no recognition of mutuality, no fusion of interests, no co-operation. It does not touch the rank and file. It applies to the very portion which neither requires it as a spur nor deserves it as justice. The men to whom it does apply are paid by weight; and the incentive of increased pay, by reason of increased production, will inevitably hold them up to their utmost efforts. Of a thousand men, nine hundred and fifty, embracing every variety of labor, earning from $1.25 a day upward, go moping around at a snail's pace, doing the least amount of work that will hold the job, anxious to make work for as many as possible, and utterly indifferent whether a slight break-down stops a thousand men for an hour, or whether oil, coal and waste are saved or squandered. There is no inducement on the part of either those who share in the sliding scale, or those who do not, to economize in material or improve in methods. Every improvement in machinery implies a corresponding reduction in the scale at the next settlement day. Why should the worker facilitate or welcome economical contrivances? His interest is confined to his own day's wages, and his employer's or his fellow's income is no concern of his.

The highest value of profit sharing lies in its influence in bringing proprietor and employe together. It breaks down the wall which separates them. It teaches them that constructive co-operation is better than destructive opposition. When a mutually satisfactory plan of apportionment of profits is reached—and this is not difficult—then mutual interest is self-evident. The tendency becomes inevitable to make the most of united effort. Under the sliding scale, it is not pretended that one workman or all the workmen can in the slightest degree affect the sum out of which the increased pay comes. In profit sharing every man knows that he and his fellow-employe can and do affect their individual incomes. Individual interest and common interest are bound up together. Proprietor and employe alike know that indifference reacts upon themselves. If there is any truth in the asserted superiority of free labor, then there is superiority in interested labor.

Had Mr. Carnegie adopted a liberal system of profit sharing, what would have been the result? To skilled men he would have paid the association rate of wages prevalent throughout the country, and to ordinary mechanics and laborers, the day rate current in the Pittsburgh district. During the six years in question the steel industry has been, on the average, highly profitable. It has been protected by an import duty, and home competition has been forestalled by combinations. A liberal dividend could have been paid upon wages, perhaps as much as 10 per cent., without reducing the earnings of capital below a rate at which an abundance of it would gladly seek investment.

In large industrial operations, such as railroads and iron works, services are apt to be extremely slipshod and wasteful. It is more than probable that, after dividends had been paid for a year or two, the extra earnings due to superior care and alacrity would yield a good dividend to wages without drawing anything whatever from the ordinary earnings of capital.

Profit sharing would have exactly suited the theory of stewardship which Mr. Carnegie promulgated. It would have increased the income of all his fifteen thousand men by a sum which would have enabled them to live in better houses, eat better food, and send their children more to school. For the libraries and art galleries to which his millions have been diverted, these men have no adaptability; nor will their children have, if they are brought up under the average mill conditions.

Not only are more pay and steadier work prime conditions in the safety and improvement of society—a fuller recognition of mutual duties and equal rights is demanded. Profit sharing is a beginning of democracy in business, through which we may find the way out of war into peace.

N. O. NELSON, in *Employer and Employed.*

MANUFACTURES.

The Blair Milling Company are going to erect another large mill at Atchison, Kansas.

Citizens of Brooks (Me.) have subscribed $14,000 toward starting a shoe factory in the village.

Stephen Smith and others, of Marshfield, Me., are building a mill at Mark's Lane, Me., to saw laths, spool wood, etc.

The Hill Harber Harness Co. has recently incorporated, with $25,000 capital, and will be located at Bloomington, Ill.

The Atchison (Kansas) Furniture Co. has been reorganized, with the veteran iron founder, John Seaton, as president and acting manager.

The Forbes Malleable Iron Works, at Rockford, Ill., are building an addition to their foundry that will give working room for seventy-five molders.

The Chambers Glass Works, Kensington Va., Pittsburgh district, was formally put in operation October 8. It is the largest window glass plant in the world.

The J. L. Taylor Pipe and Nut Wrench, which we illustrated in our issue of Nov. 3, is now being handled by Wm. Dodman, 103 Chambers street, New York.

The Beaver Dam (Wis.) Malleable Iron Company has been incorporated, and a site selected for the works. J. F. Boynton, Julius Hanneman, etc., are incorporators.

A charter was granted to the Vulcan Works, of South Chester, Pa., October 17, to manufacture iron and steel. The capital stock of the company is fixed at $50,000.

As the result of the recent meeting of the Ohio Falls Car Company, at Jeffersonville, Ind., the stock of the company will probably be increased, and the works greatly increased.

An Electric Street Railway Company has been incorporated at Atchison, Kansas. The city council has granted franchises, and the road will be in operation inside of nine months.

A $100,000 stock company has been organized, to erect nail works and puddling-mill at Norfolk, Va. E. White is president, and M. Umstader vice-president. Site for the plant has been chosen.

The vitrified brick plants at Atchison, Kansas cannot fill their orders for paving brick. This clay is said to be the best in the West. There is an opening for a plant with improved machinery.

The Columbia Iron Company, of Columbia, Pa., have purchased at private sale 150 feet of ground adjoining their mill on the north, from Edward K. Smith. They will enlarge their mill in the spring.

Articles have been filed with the Secretary of State of Illinois, incorporating the Hepburn Baking Co., with a capital of $15,000. The incorporators are: W. M. Hepburn, Andrew Silver and James Ferguson.

The State Machine Company, Hartford, Conn., issue a very neat catalogue of boring and milling machines, countershafts, self-oiling pulleys, etc. The catalogue will be of interest to engineers and mechanics.

Charles Lowe is to build a new mill at Costigan, Me., to be fitted with a rotary, and saw both long, and short lumber. The building is to be 140x40 feet, located one-fourth of a mile above the station at Costigan.

The Beverly (Mass.) Building Association has awarded contract to build shoe factory. It will be 110x45 feet, five stories high, and is to be completed in twenty-four days. It will be occupied by Millet, Woodbury & Co.

The Panel Chair Company has filed notice of the increase of their capital stock from $10 000 to $30,000, and of their removal from Chicago to Bloomington, Ill. Mr. A. M. Richards is president of the company.

Goudy & Kent, bakers and confectioners, of Portland, Me., are building a new factory. With an equipment of two ovens and three reels, the new bakery will have a capacity of consuming 100 barrels of flour daily.

The Blue Hill Granite Company, of Maine, has been organized at Blue Hill, Me., with $100,000 capital stock. The officers are: President, L. D. Willcutt, of Cohasset, Mass.; treasurer, Edmund Davis, of Hyde Park, Mass.

The Richards Paper Co.'s mill at Gardiner, Me., has been purchased by S. D. Warren & Co. The machinery equipment is hardly up to modern requirements, and will doubtless be extensively altered and improved.

M. C. Bullock Manufacturing Company, Chicago, Ill., write us: We are running 23 hours out of 24 and regard the outlook for trade as very bright. All of our various specialties are included in the demand for our machinery.

John Rjelin, a Swedish steel worker, is endeavoring to organize a company of Swedish capitalists in McKeesport, Pa., to manufacture razors, knives, scissors, etc., from Swedish steel. A site has been donated, and some of the stock is already subscribed.

The plans of the new structure to be occupied as the shops of the Fulton Iron Works, Oakland, Cal., have been drawn, and preparations are now under way for their erection. The proprietors propose to compete with the Union Iron Works for the construction of government vessels.

A large English bicycle manufactory has written to the industrial department of the Chicago, Milwaukee & St. Paul Railway, stating that it contemplates locating in the vicinity of Chicago or Milwaukee, and asking for information as to supplies of material, power, labor, and the general situation.

The Pilling Shoe Co. which is located in Lowell Mass., has completed arrangements by which the erection of a four story brick factory, 200x45 feet, will be commenced. The factory will turn out women's, misses' and children's boots, shoes and slippers, and will give employment to from 300 to 400 hands.

The Tudor Iron Works contemplate the erection of a 12-inch mill, in addition to their present plant at East St. Louis, to employ about 100 men. The building will be fire-proof, 200x100 feet, and the company's mechanics are now beginning the work of construction in a preliminary way. The works are at present fairly well employed, and about 800 men are kept busy full time.

A furniture factory is among the latest projected additions to the already numerous industries of Monterey, Mexico. The company has been organized, a site has been secured from the government of Nuevo Leon, Mexico, and the company is to be exempt for fifteen years from all city and municipal tax on its capital, which is not to be less than $200,000. The factory is to be in running order within seventeen months.

There is water-works agitation at Saltsburg, Pa; Hamilton, O.; Hull, Ill.; Ocala, Fla.; Elkhart, Ind.; Norwood, O.; Rochester, N. Y.; Middletown, N. Y.; Connellsville, Pa.; Boonton, Pa.; Mahanoy City, Pa.; Provincetown, Mass.; Woonsocket, R. I.; Swanton, Vt.; Blaine, Me.; Worcester, Mass.; Greenfield, Mass.; Orilla, Ont.; San Luis Obispo, Cal.; Modesto, Cal; Sehachapi, Cal.; Jersey City, N. J.; Renova, Pa.; Athens, Tenn.; Greenville, O.; Altoona, Pa.; Erie, Pa.; Depew, N. Y.; Van Buren, Ark.

Dr. J. F. Hill, of Augusta, Me., when in Chicago recently, made arrangements with the proprietor of an electrotype founder of the windy city to come to Augusta, Me., and establish a plant. Dr. Hill is now looking up a suitable location for the foundry. With the immense business of publishing firms like Vickery & Hill and the Gannett & Morse concern, business that is now sent to the Boston electrotype foundries, it would seem that this new venture of the Chicagoan would meet with success.

The Rumford Falls Sulphite Company has been organized at Portland, Me., with $200,000 capital stock, for the purpose of manufacturing and dealing in all kinds of pulp, paper and fiber. The officers are: President Allan W. Fletcher, of Detroit, Mich.; treasurer, Hugh J. Chisholm, of Portland. The new company proposes to build at Rumford Falls, Me., this winter, the largest sulphite pulp-mill in the State. Work is to be begun immediately, and the penstocks are to be put into the middle level canal before the water is let in. The mill is to be built under the supervision of Engineer Tower, of Holyoke, Mass.

The Port Clyde Marine Railway Company was organized at Thomaston, Me, recently, with a capital stock of $20,000, all paid in, and the following list of officers: President, Francis A. Washburn; treasurer, George S. Washburn; directors, James Overlock, Francis A. Washburn, Edwin P. Washburn, William G. Washburn. The declared purposes of the company are the building and operating of marine railway docks and wharves for the construction and repair of vessels of every class, steam and sail; doing a towing, freighting and passenger business on the Georges River, tributaries and the high seas; the carrying on of the fishing and canning business in every form; the erection of elevators and mills for the storing and grinding of corn, and the doing of a trade in general merchandise. The concern is an extensive one and has been in existence several years, doing business at Thomaston and Port Clyde.

The Curtis Regulator Company, of 63 Beverly street, Boston, have removed to 29, 31, 33 Haverhill street, where they have extensive salesrooms and offices in a large new building of five stories and basement, measuring 75x45 feet. The great increase in the business of this concern has necessitated this move, as well as the building of an extensive new factory in Charlestown. This structure is of a most substantial construction of heavy brick walls, and measures 105x45 feet, and is five stories in height. It is supplied with a 100 horse-power Ball and high-speed compound engine, and a locomotive boiler. The building is supplied with its own dynamo and electric lights, and a track of the Boston & Maine Railroad runs into the premises. With these facilities the Curtis Regulator Company is prepared to accept orders for all kinds of high-class machinery work, patent articles and specialties. It has been successful in this line of business for upwards of 14 years.

The Whitman Agricultural Works, Auburn, justly rank among the most flourishing industrial establishments in Maine. They have only recently completed an extensive addition to their machine shop and are now breaking ground for another important addition to their extensive plant. This new building is to be 90x40, five stories in height, including basement, and will be connected with the main factory by a steel bridge 90 feet long and extending over the Grand Trunk Railroad. The equipment of the new building will include an elevator from Morse, Williams & Co., 13 Lincoln street, Boston, the elevator being 12x8 feet, and having a capacity of three tons. When this new building is completed the Whitman Agricultural Works in the various departments of their extensive plant will have at their command about 60,000 square feet of floor surface. A dynamo of 150-light capacity has just been introduced, and the various buildings are now brilliantly lighted with the electric light. The system is the Mather, and was put in by C. B. Storey, of Brunswick.

The additions to the shops of the Lansberg Brake Company, of St. Louis, Mo., are now completed, and the machinery has been placed therein. The building is now two stories in height and has almost twice its previous width. There are twelve new machines on the second floor. Even with these increased facilities the company are pushed to their utmost, and have orders enough on their books now to keep them busy for an entire year. Sixty skilled workmen are given constant employment. The new machine tools that have been added to the equipment are mostly of the Lodge & Davis make, exceptions being the boring machine bought of the George A. Gray Company, of Cincinnati, and the New Haven lathe, 32 inch swing and 14-foot bed, purchased of the New Haven Manufacturing Company, New Haven, Conn. Brakes are being turned out at the rate of 350 to 400 a week. The company are also building a pump for general railroad use, which, it is claimed, has several points of superiority over other makes. Patents are now pending for these improvements. Preparations are now being made to have the company's offices and shops heated by steam.

The Mechanical Rubber Company, capital stock $15,000,000, has been incorporated at Trenton, N. J. At a meeting held October 17, in Jersey City, the following officers were elected: William Barbour, Henry W. Cannon, president of the Chase National Bank of New York; Oliver S. Carter, president of the National Bank of the Republic, New York; James B. Ford, president of the Meyer Rubber Company, New Brunswick, N. J.; Henry L. Hotchkiss, president of L. Candee & Co., New Haven, Conn.; D. H. King, Jr., New York; William C. Martin, president of the New Brunswick Rubber Shoe Company, New Brunswick, N. J.; J. Edward Simmons, president of the Fourth National Bank, New York; John P. Townsend, president of the Knickerbocker Trust Company, New York, and Ebenezer K. Wright, president of the National Park Bank, New York. The company has been incorporated to manufacture hose, belting, packing, pneumatic tires, druggists' sundries, and mechanical rubber goods generally.

Machinists' Supplies and Iron.

NEW YORK, November 12, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $15 to $15.50; No. 2, $14 to $14.50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $15 to $15.50 for No. 1 Foundry; $13.50 to $14 for No. 2; and $12.25 to $13 for Gray Forge.

Scotch Pig—Coltness is quoted at $21; and $20 for Eglington.

Antimony—The market is improving in price. We quote L. X., 11¼c. to 11½c.; Cookson's, 12c. to 12½c.; Hallett's, 10¾c. to 11c.

Copper—The market is dull. Lake Copper is quoted at 11¾c. to 12c. Casting Copper is held at 10½c. to 10¾c.

Lead—The market is unchanged; the quotations remain at 3.85c. to 3.90c.; the prospects are better.

Lard Oil—Prime City is quoted at 75c. to 76c.; Western on spot at 74c. to 76c.

Spelter—The market continues dull and nominal at 4.40c. to 4.45c.

Tin—The market is easier, and operations are very light. Some business has been transacted at 20.60c. to 20.70c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Agents to sell calipers, etc.; liberal inducements. E. G. Smith, Columbia, Pa.

Mechanical draftsman, two years prac. exp., is open for engagement. L., AMERICAN MACHINIST.

Mech. draftsman, graduate, shop and office exp., wants position. O. M., AMERICAN MACHINIST.

First-class draftsman and machinist wants position. Address M. F., AMERICAN MACHINIST.

Wanted—A machinist as working foreman, 100 miles south of New York. B. M. W., AM. MACH.

Experienced mechanical draftsman wants situation in New York or vicinity. Box 38, AM. MACH.

Educated American, 21, wishes to become a draftsman; slight experience. A. E., AM. MACHINIST.

Wanted—Twenty-five good machinists. Apply to Bath Iron Works, Bath, Maine.

Wanted—At once, a good vise hand for erecting milling machines and shapers. State where employed, age, wages expected. Box 40, AM. MACH.

Wanted—An experienced draftsman, accustomed to engine and saw-mill machinery. Address Box 465 Vancouver, B. C., Canada.

The supt. and chief eng. to the Goulds Mfg. Co., Seneca Falls, N. Y., is open for engagement Jan. 1, 1893. Address R. H. Aldrich, Seneca Falls, N. Y.

Wanted—Position as chief draftsman or ass't to superintend't, by a mech draftsman who has had 10 years practical experience. Box 33, AM. MACHINIST.

Wanted—Position as sup't or foreman; successful in the systematic mfg. of machine tools, automatic & interchg'ble mach'y. H., Box 310, Florence, Mass.

Wanted—2 or 3 first-class lathe and boring mill hands. General machinists preferred. Call 24 Morris street, Jersey City, 2d floor.

Competent machinist desires a chance; first-class on experimental and light machinery, also small punches and dies. C. H., AMERICAN MACHINIST.

Wanted—Three planer hands, 3 lathe hands, and 2 floor hands, all first-class men. Sioux City Engine Works, Sioux City, Iowa.

Wanted—First-class tool maker for brass work manufacturing steam and plumbing goods. Apply to the Ahrens & Ott Mfg. Co., Louisville, Ky.

1st-class draftsm. wants sit.; general and special mach., power transmissions, tools; thor. technical education; good mathematician. K. K., AM. MACH

Wanted—Expert planer hand to take charge of planer gang on Corliss engine and heavy work in good shop; good pay to man exp'd in reducing cost. Address Henderson, care AMERICAN MACHINIST.

Wanted—A first-class draftsman competent to take entire charge of our drawing-room. Address, stating experience, and salary required, Sioux City Engine Works, Sioux City, Iowa.

Wanted—Die sinker; must be experienced in sinking dies for general drop forge work. Permanent position at good pay for right party. Philadelphia Drop Forge Co., American & York Sts., Phila., Pa.

Wanted—Position as superintendent or assistant on machine tools, engine, electrical and general work. Designer of special tools, etc., good manager, and up in modern methods. Box 36, AM. MACH.

Wanted—Immediately, two good and well-experienced vise hands for engine work; one good gen. blacksmith; permanent pos. for suitable men. Apply or address, Kenney & Co., Scottdale, Pa.

Wanted Mech. draftsman; must be thor. acquainted with latest designs of printing and folding machinery; steady position to right man; state exp. and where last employed. Box 31, AM. MACH.

Wanted—Position as chief engineer of large power plant, where economical management will be appreciated. Have had an extensive experience erecting, repairing and running. B., AM. MACH.

Wanted, Designers—Two or three first-class men familiar with designing fine machinery, tools, fixtures and gauges; state amount of experience, and salary wanted. Webster Mfg. Co., Chicago, Ill.

A first-class machinist and tool maker, familiar with steam and hydraulics, accustomed to laying out work and management of men desires a position of trust and responsibility; best refs. for character and ability. Address Box 37, AM MACHINIST.

Wanted—Foreman for foundry making machinery and cylinder castings; must be a man of ability, energetic and reliable; state nationality, references, and salary expected. Address H., AM. MACHINIST.

Wanted—Mech. draftsman; a graduate with some experience preferred; must be industrious, correct and quick; to such a permanent position is assured; state experience, and wages expected. The Western Gas Construction Co., Fort Wayne, Ind.

Position in charge with live company wanted, by thorough mechanic, experienced in developing light machinery, and patented articles, and building tools for mfg. same; similar position held for past 8 years. Address "Mass," care AM. MACH.

Mech. draftsman, with good theoretical education, and 11 years prac. exp. in machine shop and drawing office, wishes sit. as ass't supt. or draftsman. Is a specialist in designing & erecting mach. shops & factories, and on erection of steam plants, mach'y, transm'n of power, etc. Box 39, AM. MACH.

Wanted—A comp't mach. shop foreman acenst'd to mod. prac. on Corliss engines and other engine work; to one that has made an actual success (and none other need apply) a liberal salary will be paid; give present employment, age, and salary expected, and how soon you can report. Box 29, AM. M.

Wanted—An exp'd salesman for N. Y. City and vicinity to exploit and sell Corliss engines; must be comp't to adjust engines, and know when they are prop'y erected, etc.; none but a man of address & good knowledge of steam machinery will meet our views; state experience, age and salary. Address Box 30, AMERICAN MACHINIST.

A young graduate mechanical engineer is open to engagement. The advertiser is experienced in the modern design & installation of power stations for electric light & railways, well posted on all details of the work, and has a thorough knowledge of building materials. Can also estimate on and test complete plants. Terms moderate. A1 refs. Progressive, Box 110, AM. MACH.

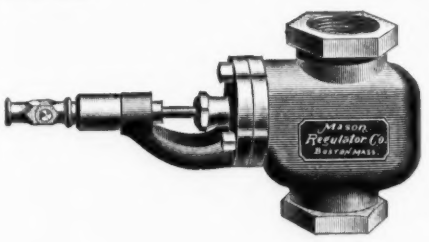
Bradley Hammers.

If you plate, draw, square, taper, swage, collar, spindle, or do any manner of die forging in iron or steel, a BRADLEY HAMMER will soon pay for itself, by what it will save over any other similar tool. Send for circulars.

BRADLEY & COMPANY, SYRACUSE, N. Y.

THE MASON BALANCE VALVE

Is a double piston balance valve, for use in connection with our speed governor, and for which we have found a ready sale in the many cases where such valves are used. The principal advantage of our valves is in the guide for the valve stem, which is cast on the bonnet, thereby keeping the valve stem in a direct line with the stuffing box. For this reason it is impossible for the valve stem to bend, and the packing seldom has to be renewed. The sizes up to two inch are made of the best steam metal; above that, of cast iron, lined with steam metal. A knuckle-joint tapped for three-eighths rod in on the same stem of each valve. This saves expense in making connections.



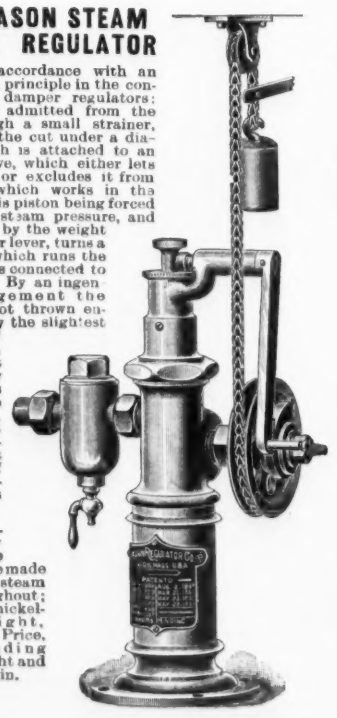
THE MASON LEVER VALVE

Is made essentially the same as the "Mason Balance Valve," with the substitution of yoke and lever with weight attached for the bonnet and knuckle joint of the balanced valve. The lever valve will be found useful in controlling the supply of water in tanks by attaching to a ball float. It can also be used to control steam pumps in tank service, by placing the valve in the steam supply pipe to the pump and connecting the lever with a ball float placed in the tank. There is no lost motion in any of the joints, a fact which those desirous of close regulation will appreciate. These valves can be furnished either as piston or seated valves. The latter style is steam tight.

THE MASON STEAM DAMPER REGULATOR

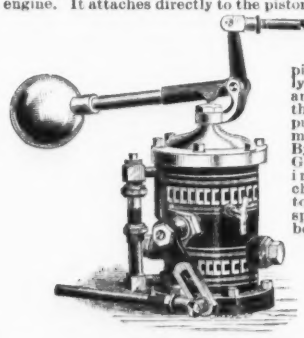
Is made in accordance with an entirely novel principle in the construction of damper regulators: the steam is admitted from the boiler, through a small strainer, as shown in the cut under a diaphragm which is attached to an auxiliary valve, which either lets in the steam or excludes it from the piston which works in the cylinder. This piston being forced down by the steam pressure, and carried back by the weight on the damper lever, turns a wheel, from which runs the chain which is connected to the damper. By an ingenious arrangement the damper is not thrown entirely open by the slightest change of pressure in the boiler, but is gradually opened, as the pressure changes, thereby not allowing sudden and great variations of draft, whereby the coal is wasted.

We manufacture only one size. The regulators are made of the best steam metal throughout; each one is nickel-plated. Weight, 30 pounds. Price, $80.00, including bracket, weight and 25 feet of chain.



THE MASON PUMP GOVERNOR.

The Mason Pump Governor is to the direct acting steam pump what the ordinary ball governor is to the steam engine. It attaches directly to the piston rod of the pump and operates a balanced valve placed in the steam pipe, thereby exactly weighing the amount of steam to the needs of the pump, and economizing the same. By using the Mason Governor, you can instantly set or change your pump to any required speed, which will be maintained in spite of variation in load or steam pressure. As all the working parts of the governor are immersed in oil, the wear is reduced to a minimum. It is largely used on vacuum pumps, deep well pumps, water works pumps, ice machines, and all classes of pumps requiring an uniform strike.



MANUFACTURED BY

MASON REGULATOR CO.,

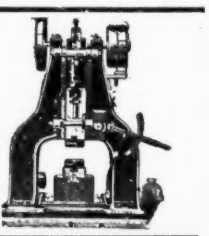
Boston, Mass.

HACKNEY HAMMERS

Meet all requirements more fully and satisfactorily than any other of its competitors.

INVESTIGATION IS NOT COSTLY.
INVESTIGATION IS CONVINCING.

WRITE FOR CATALOGUE TO
THE HACKNEY HAMMER CO.
20 Johnson St., CLEVELAND, O.



VANDERBEEK'S
TRADE MARK.

MILLING MACHINE.
FIVE STYLES.
THE STATES MACHINE CO.,
HARTFORD, CONN.

5th EDITION READY.

Stationary Steam Engines

for Electric Lighting Purposes.
By Prof. R. H. THURSTON.
12mo, Cloth, $1.50.
JOHN WILEY & SONS, NEW YORK.

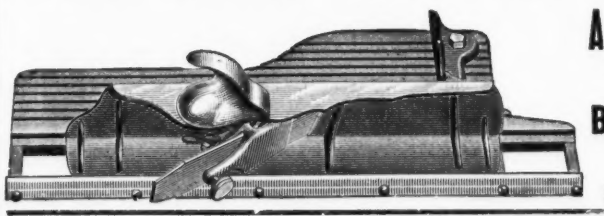
CLAMP DRILLS.

No. 1.—Weight,	30 lbs.,	Price, $15.
No. 2.— "	40 "	" 20.
No. 3.—Geared,	40 "	" 20.
No. 4.— "	50 "	" 25.

Liberal Discount to the trade. Send for circular of full description. Also light-drilling machines for Hand and Power.

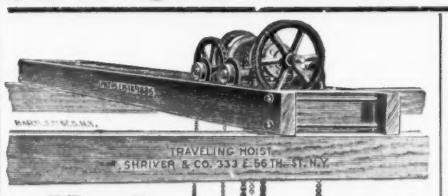
GEO. BURNHAM & CO., Worcester, Mass.

PATTERN MAKERS' SHOOT PLANE & JACK BOARD.



A. J. WILKINSON & CO.
Box 3600,
BOSTON, MASS.

SEND FOR CIRCULAR.



No. 1
TRAVELING CRANE,
CAPACITY, 3,000.
On Wood Overhead Beams.
PRICE OF MACHINE, - - $100.00.
Timber, Bolts, Track Iron for overhead frame, 11.50.
Send for Illustrated Circular, giving full details.
T. SHRIVER & CO. 333 E. 56TH ST. NEW YORK.

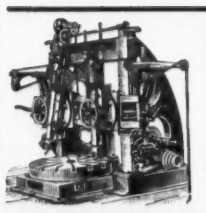
BRASS-WORKING TOOLS.

SPECIAL MACHINERY.

BARDONS & OLIVER
Cleveland, Ohio.

PRICES on APPLICATION

SCREW MACHINES.



BORING AND TURNING MILLS

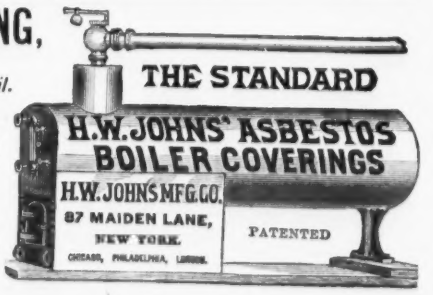
COMBINING EVERY IMPROVEMENT.
14 SIZES—FROM 5 TO 20 FEET.
BETTS MACHINE COMPANY,
WILMINGTON, DEL.

ASBESTOS CEMENT FELTING,

FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.



Experienced man wants position as designing draftsman. BOX 42, AMERICAN MACHINIST.

A Mfg. Co. in Virginia want the services of a competent man as sup't of their works; should be an educated mechanic, competent to handle men, and turn out good work to the best advantage; work both wood and iron; one with experience in hydraulic press work would be preferred; to the right man with some capital an interest could be arranged for, but this is not essential; we want the right man, not the money. Address "Manufacturer," Richmond, Va.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 25 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d-hd lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Gang & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Screw-cutting lathe, 26" swing, and costly chucks and tools, $230. 229, AMERICAN MACHINIST.

For Sale—Machine shop; new tools; good location; no opposition; reasons for selling, death. Address BOX 41, AMERICAN MACHINIST.

Wanted—Hardware specialties to build. Send 25 cents for "Eureka Knife and Shears Sharpener." W. A. Smith & Co., 227 Eddy Street, Providence, R. I.

Designs & work'g draw's of marine & stationary eng's & boilers, gen'l mach'y, patent drawings. C. A. Blomberg, 2262 North 19th St., Philadelphia, Pa.

For Sale—Corliss steam eng. 100 H. P., with boilers, shafting, etc.; a bargain for some one. Address Orrin E. Jones, 416 High St., Providence, R. I.

We will pay 25 cents each for copies of the AMERICAN MACHINIST of December 25, 1886, issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Special, experimental or other light machinery manufactured. Best equipped shop in the West for fine work. Manufacture one of the best hollow spindle bench lathes for the tool room or for manufacturing. Write us. Moseley & Co., Elgin, Ill.

Wanted—Compound eng. with feed-water heater, vacuum and condensing pumps, for steam launch 30 feet by 7 feet. Said launch has upright tubular Robinson boiler, 30x46 inches, with allowed pressure of 140 pounds, which, with present single engine, 4¼x6 inches stroke, develops speed of 9 miles. Address Box 1044, Providence, R. I.

MACHINE TOOLS

IN STOCK.

LATHES.

All sizes of FLATHER.
" " BLAISDELL.
" " FIFIELD.
One each, 14"x6' and 24"x12' FITCHBURG.
One 78"x15' SELLERS.

PLANERS.

All sizes of WHITCOMB.
" " FLATHER.
One each, 30 'x8' and 36"x8' PEASE.

DRILLS.

All sizes of PRENTICE.
" " BLAISDELL.
One 5' CINCINNATI RADIAL.
One 8" NEWTON SLOTTER.
All sizes of HENDEY and EBERHARDT SHAPERS.

WRITE FOR PRICES.

HILL, CLARKE & CO.,

156 OLIVER ST., BOSTON, MASS.
CHICAGO BRANCH, 12 and 14 South Canal Street.

SECOND-HAND AND NEW MACHINERY.

ON HAND.

84 in.x72in.x12 ft. Planer 2 Heads, H. & P.
10 ft.x10 ft.x16 ft. Planer. 1 Head.
62 in.x61 in.x9 ft. 2 Heads, Bement.
72 in.x48x30 ft. 3 Heads.
62 in x48 in.x17 ft. do 1 do
54 in.x42 in x24½ ft. do 2 do
42 in x42 in.x16 ft. do 1 do
39 in.x36 in.x12 ft. do 1 do
36 in.x38 in.x8 ft. do Powell A1.
30 in.x30 in.x7 & 8 ft. do 1 Head.
26 in.x26 in.x6 ft. do 1 do
25 in.x24 in.x6 ft. do 1 do
22 in.x21 in.x5 ft. do 1 do
98 in.x30 ft. Engine Lathe, Putman.
90 in. x30 ft. Triple Gear Engine Lathe, Ames A1.
50 in.x30 ft. Bed, Triple Geared. New Engine Lathe.
30 in.x28 ft. D. W. Pond Shafting Lathe.
32 in.x12, 14, 16, 18 ft. Bed. New Engine do
28 in.x12, 14, 16, 18 ft. do do do do
21 in.x10, 12 ft. do do do do
20 in.x 7½ & 8 ft. do 2d Hand do do
18 in.x 6, 7 & 8 ft. do New & do do do
17 in.x 8 ft. do do do do
16 in.x 6 & 8 ft. do do do do do
15 in.x 6 & 8 ft. do do do do do
14 in.x 6 ft. do do do do do
Car Axle Lathe, Bement.
9 & 12 in. Stroke Slotters.
15, 16, 18, 25 in. Crank Shapers.
20, 24, 26 & 30 in. Geared Shapers.
20, 22 24, 28, 30 & 36 in. Drills.
Bolt Cutters.
1 Bk. Geared Miller. U. V. Co. Good.
1 Brainerd No. 3 Miller, A1.
1100 and 3000 lb. Bement Steam Hammer.
100 and 150 lb. Steam Hammer
42 in. Sellers Hyd. Wheel Press.

GEO. PLACE MACHINE CO.,
120 BROADWAY, NEW YORK

SECOND-HAND MACHINERY

For Sale at Very Low Prices.

One 72x72x16 Iron Planer.
One 60x60x20 Iron Planer.
One 48 in. Swing Holly Lathe.
One 19½ in. dia., 30 in. stroke, single cylinder poppet valve, horizontal steam engine, good as new.
Write for prices.

HOLLY MANUFACTURING CO., Lockport, N. Y.

DESIRABLE SECOND-HAND MACHINERY.

LATHES.

16 in. x 8 ft. Bement, Gib Rest, 12 in. 4-Jaw chuck. Heavy Good Tool. A1 condition.
15 in. x 8 ft. Blaisdell, Rise and Fall Rest, Power Cross Feed. Good as new.
16 in x 6 ft. Hatfield, Rise and Fall Rest, complete. Good as new.
15 in. x 6 ft. Blaisdell, Rise and Fall Rest, Chuck and Tools. Good order.
13 in. x 5 ft. Pratt & Whitney, Plain Turning, Rise and Fall Rest, Auto Stop to Feed. Good as new.

PLANERS.

42 in. x 36 in. x 13 ft. Gleason, Improved, one Head on Rail. Good as new.
30 in. x 30 in. x 8 ft. Hewes & Phillips, one Head, Spiral Geared, Fine heavy Tool. Good as new.
20 in. x 16 in. x 5 ft. Lincoln, with Index Centers. Good order.
18 in. x 22 in. Blaisdell Crank Planer. Good as new.

MISCELLANEOUS.

24 in Drill Press, Back Geared, Sliding Head, Wheel and Lever Feed. Good as new.
6-Spindle Garvin Drill Press. Good as new.
4-Spindle Pratt & Whitney Drill Press. Good as new.
16 in. Wright Geared Friction Shaper. A1 condition.
No. 4 Stiles & Parker Power Press. A1 condition.
3 No. 2 Brown & Sharpe Screw Machines Auto. Chucks. Wire Feed, complete. A1 condition.
1 Brown & Sharpe Surface Grinder. A1 condition
1 Whiton 2-Spindle Centering Machine. Good as new.
15 in. x 5 ft. Lodge & Davis, Turret Lathe, 4 Spring Chucks, 3 box tools. Good as new.
No. 4 Garvin Miller, Overhanging Arm, Power Feed. Good as new.
No. 2 Garvin Miller, Power Feed with Vise. A1 condition.
Merritt Heavy Back Geared, Miller, with Arm, 36 in. x 12 in. Table, 3 "T" Slots. A1 condition.
400 other new and second-hand tools in stock. Write for full list and prices.

THE GARVIN MACHINE COMPANY,
LAIGHT AND CANAL STS. NEW YORK

FOR SALE.

HEAVY OLD STYLE LATHE, 60 in. x 20 ft., with 57 in. Face Plate. Fair order. Price $350.
ENGINE LATHE, 32 in. x 12 ft. Complete. Latest pattern.
ENGINE LATHE, 28 in. x 16 ft. Complete. Latest pattern.
PUTNAM LATHE, 24 in. x 12 ft. Cpd. rest and cross feed.
AMES LATHE, 20 in. x 10 ft. Cpd. rest and cross feed.
NEW HAVEN LATHE, 18 in. x 8 ft. Complete.
IMPROVED ENGINE LATHE, 13 in. x 6 ft. Hollow spin. 1 1-16 hole. Cpd. rest and cross feed.
WHITCOMB PLANER, 24 in. x 5 ft. Good.
HEAVY PLANER, 54 in x 20 ft. Good order.
FITCHBURG SHAPER, 14 in. stroke, with traveling head. Complete. Latest pattern. Good as new.
GOULD & EBERHARDT SHAPER, 16 in. Late pattern. A1 order.
HENDEY SHAPER 24 in. A1 order.
SLOTTING MACHINE, 8 in. stroke. Modern.
UPRIGHT BORING AND TURNING MILL, 38 in. Latest pattern. Good as new.
JONES & LAMSON No. 11 SCREW MACHINE, 2½ hole. Chasing Bar, Turret Feed. Complete with pump, chucks and tools.
BROWN & SHARPE NO. 5 SCREW MACHINE. Complete with auto. chuck.
PRATT & WHITNEY 4 SPINDLE DRILL. Latest pattern. Good as new.
RADIAL DRILL, 86 in. Improved style.
BLISS STYLE No. 20 PRESS. Good as new.
BOILER BENDING ROLLS. "Improved style," 8 and 10 ft. Hinged housings.

Write for what you want to **Buy, Sell or Exchange.**

J. J. McCABE,

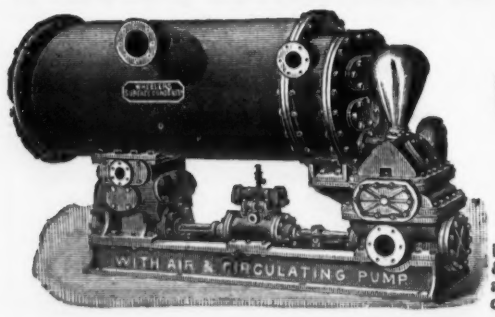
SUCCESSOR TO
E. P. BULLARD'S
N.Y. Mach'y Warerooms.
68 Cortlandt Street,
NEW YORK.

JESSOP'S STEEL

FOR TOOLS, DRILLS, DIES, &c.

ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
Chief Am. Office, 91 JOHN ST., N. Y.
WM. JESSOP & SONS, LD.

WHEELER CONDENSER AND ENGINEERING CO.



92 & 94 Liberty Street, New York.

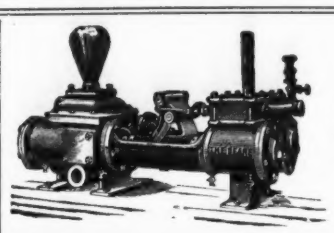
MANUFACTURERS OF IMPROVED

SURFACE CONDENSERS.

ALSO SUCCESSORS TO THE

Colwell Iron Works.

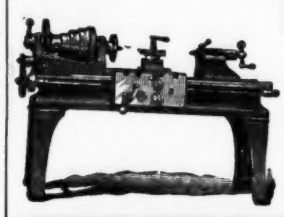
Machinery for Sugar Plantations and Refineries. Vacuum Pans, Double and Triple Effects, &c. Blowing Engines for Blast Furnaces. Iron and Brass Castings for the Trade. Heavy Machinery a Specialty.



THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

CRESCENT STEEL CO.
PITTSBURGH.
CHICAGO
NEW YORK

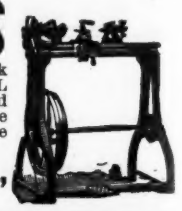
STEEL OF THE FINEST QUALITY MADE FOR
DIES, PUNCHES, MILLING CUTTERS, TAPS, REAMERS,
AND OTHER FINE TOOLS REQUIRING GREAT ENDURANCE OF CUTTING EDGES.



FOOT AND POWER LATHES

for ELECTRICAL and EXPERIMENTAL work for TOOL-MAKERS, GUNSMITHS and GENERAL MACHINE SHOP WORK. Elegant in design and superior in construction. The cheapest in the market, quality considered. Write for Catalogue and Special Discounts to

THE SEBASTIAN-MAY CO.,
SIDNEY, OHIO, U. S. A.



A NEW SCREW PLATE. THE HANDIEST PLATE MADE.

THE FULL MOUNTED LIGHTNING.

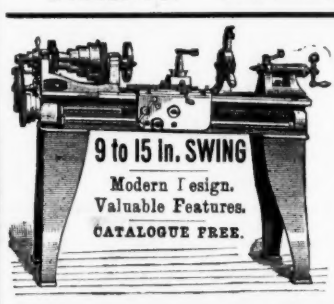
These Plates have a stock with each die. The dies are our celebrated Adjustable **Lightning** Dies. Each Stock is of correct length and weight to suit size of die. Several sizes of dies may be in use out of same set at same time. SEND FOR CATALOGUE. Made by

WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.

R. MUSHET'S SPECIAL AND TITANIC. STEELS.

How to get the best results with "R. MUSHET'S SPECIAL STEEL." Greatly increase your speeds and feeds; then compare the work you turn off with that done by any other known steel. This will make the first cost of "Mushet's" look insignificant.

B. M. JONES & CO.,
Sole Representatives in the United States.
11 & 13 Oliver St., BOSTON, MASS.
143 Liberty St., NEW YORK.



SEBASTIAN LATHE CO.

117 & 119 Culvert St., Cincinnati, O.

Manufacturers of Foot and Power

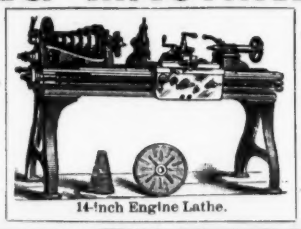
ENGINE AND SPEED LATHES,

For General Machine and Jobbing Shop, Electrical and Experimental Work.

DEALERS IN MACHINISTS' TOOLS AND SUPPLIES.

FITCHBURG MACHINE WORKS,

MANUFACTURERS OF
FITCHBURG MODERN
AND OTHER
SEND FOR CATALOGUE E.


14-Inch Engine Lathe.

THE CELEBRATED
ENGINE LATHE
METAL-WORKING MACHINES
FITCHBURG, MASS.

STEEL TUBES

WELDLESS
SMOOTH · COLD DRAWN
John S. Leng's Son & Co. New York.

STARRETT'S

FINE TOOLS

Warranted Accurate—Best in Workmanship—Latest in design—Finest in Finish—Send for Catalogue.

L. S. STARRETT,
Athol, Mass., U. S. A.
LONDON AGENTS: Chas. Churchill & Co., Ltd., 21 Cross St., Finsbury, E. C.

EVERY MACHINIST

SHOULD HAVE A COPY OF
MONTGOMERY & CO.'S
NEW TOOL CATALOGUE.

It is a 704-page cloth-bound book. A copy will be sent, express paid, to any one sending $1.00, and the money paid for book will be refunded with first order amounting to $10.00 or over. After getting the book and examining it, if you don't think it worth what you paid, send it back, express paid, and your money will be refunded.

MONTGOMERY & CO.,
105 Fulton St., New York City.

? DO YOU CALIPER or MEASURE SIZES?

If you do, it will pay you to write for Circulars of **Beam or Sliding Calipers.** The best measuring instrument made. Address
E. G. SMITH, Columbia, Pa.

BORING & TURNING MILLS

BRIDGEPORT MACHINE TOOL WORKS

E. P. BULLARD prop'r
BRIDGEPORT, CONN.

THE LARGEST AND MOST COMPLETE FILE WORKS IN THE WORLD.

NICHOLSON FILE CO.

PROVIDENCE, R. I., U. S. A.

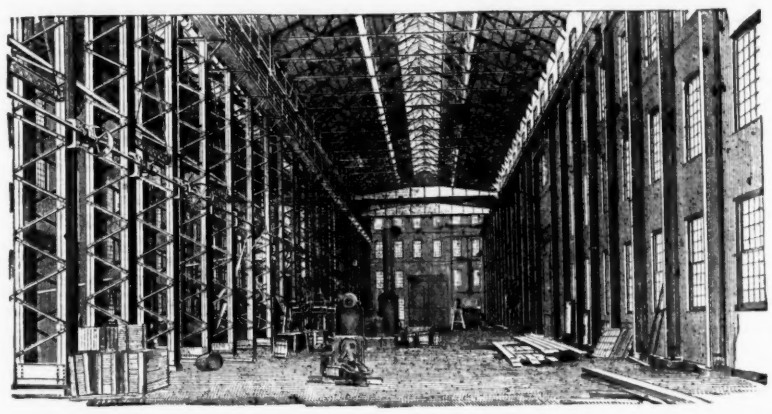
3000 VARIETIES FILES [X. F.] & INCREMENT CUT FILES.

THE BERLIN IRON BRIDGE CO.

Office and Works:

No. 8 Railroad Ave., East Berlin, Conn.

CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.



The above illustration, taken direct from a photograph, shows the interior of a Boiler Shop designed and built by us for The Newport News Ship Building and Dry Dock Co., at Newport News, Va. The building is 100 ft. in width by 300 ft. in length—the width being divided into two parts of 50 ft. each, with a row of columns through the center. The entire framework of the building is of iron, with light brick walls around the outside, placed between the iron posts. Hydraulic traveling cranes control the entire floor surface. The building is made very high, so as to allow of boilers being moved one over the other, from one part of the building to the other.

SEND FOR OUR ILLUSTRATED CATALOGUE.

LECOUNT'S NEW EXPANDING MANDREL.

Amateur's Size.

Taking anything from ⅛ to 1 inch inclusive.

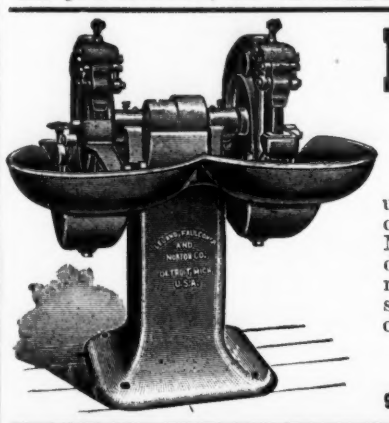
Price $5.00

Patented Dec. 25, 1877.

Machinist's Size.

No.			Price.
1	⅛ to 1	in.	$10
2	1	" 1½ "	14
3	1½	" 2 "	18
4 (with screws)	2	" 3 "	32
5 " "	3	" 4 "	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
C. W. LECOUNT, SOUTH NORWALK, CONN.
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.
These goods are for sale by CHAS. CHURCHILL & CO., L't'd. 21 Cross St., London, England.



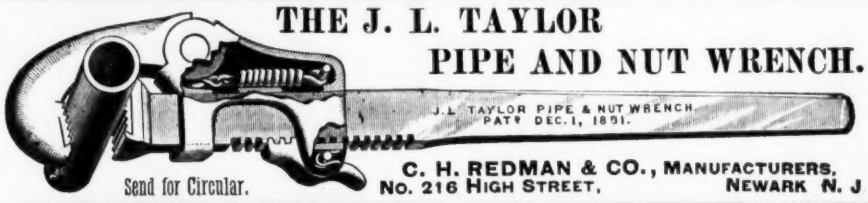
LELAND, FAULCONER & NORTON CO.

WET EMERY GRINDER.

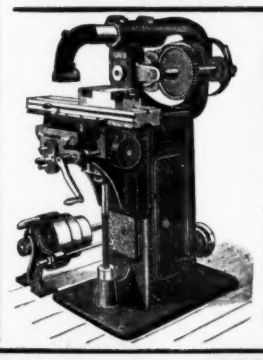
Any amount of water easily applied without the use of Pump, Hose, Treadles, Cocks, or any of the objectionable features common in this class of Machine. Truing Device, which is inexpensive, does the work perfectly and quickly. The whole rig practically as simple as the old-fashioned grindstone trough and much more effective. Send for circular.

LELAND, FAULCONER & NORTON CO.,
96 TO 106 BATES STREET, DETROIT, MICH.

THE J. L. TAYLOR PIPE AND NUT WRENCH.



Send for Circular.
C. H. REDMAN & CO., MANUFACTURERS,
No. 216 HIGH STREET, NEWARK N. J



PLAIN and UNIVERSAL MILLING MACHINES

of approved design and high grade workmanship.

KEMPSMITH MACHINE TOOL CO.,
Milwaukee, Wis.

SENSITIVE KNEE DRILL

Both hands to handle work. Double capacity over old plan.

SEND FOR CIRCULAR.

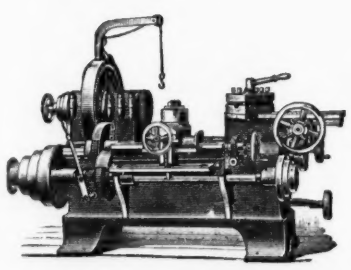
BRADY MFG. CO.,
83 Washington St., Brooklyn, N. Y.

PASSAIC ART CASTING CO.

PASSAIC, N. J. NEW YORK OFFICE 35 WARREN ST.

Fine castings by new pressure process equal to hand cut work in Bronze, Brass, Aluminum, and German Silver. Machinery Name-Plates 1½ cents per sq. inch.

EXTRA HEAVY ENGINE TURRET LATHE.



QUINTESSENCE OF QUALITIES

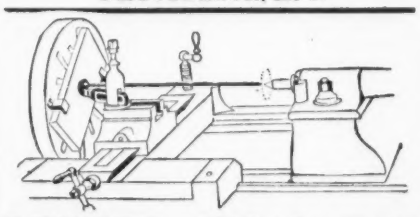
TURRET ON SADDLE IS AN ADJUSTABLE BOX TOOL.
LARGE AND LONG SPINDLE.
BED, HEAD STOCK, TAIL STOCK AND SIDE RAILS ONE AND THE SAME CASTING.
IMMENSE POWER.
ABSOLUTE RIGIDITY.
ESPECIALLY DESIGNED FOR DUPLICATING WORK.

THE LODGE & SHIPLEY MACHINE TOOL CO.,
108-115 CULVERT ST., CINCINNATI, O.

BUFFALO FORGES.

BUFFALO FORGE CO., BUFFALO, N. Y.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.



CENTER INDICATOR

Sent postpaid on receipt of $1.50.

S. A. SMITH, 23 So. Canal St., Chicago, Ill.

THE AERATED FUEL COMPANY'S SYSTEM

Gives the best oil fire. Does not increase insurance. 200 plants in use, for 50 varieties of work. Forging and Tempering a Specialty. Send for Catalogue to W. S. COLLINS, 45 and 46 Drexel B'ld'g, New York. GILBERT & BARKER MFG. CO., General Agents for the U. S., SPRINGFIELD, MASS.

COOKE & CO.,
163 & 165 Washington Street,
NEW YORK.

WATERS PERFECT ENGINE GOVERNOR.

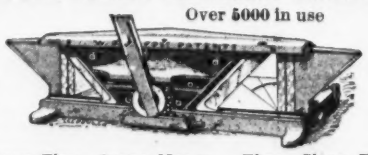
Simplest and most sensitive.

WRITE FOR PRICE LIST AND MENTION THIS PAPER.

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,
810 Walnut St., Philadelphia.

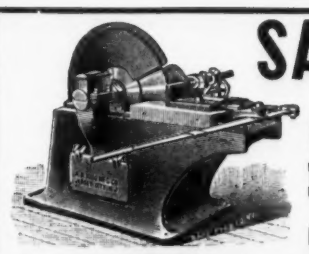
☞ Our New and Revised Catalogue of Practical and Scientific Books, 87 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

THE FOX PATENT UNIVERSAL TRIMMER.
Over 5000 in use



ORIGINAL IMPROVED

Saves Time, Saves Money. Three Sizes, Four Styles, from New Patterns. *No Pattern Room Complete without Them.* Send for Catalogue.
Beware of Imitations, we will prosecute all Infringements.
THE FOX MACHINE CO.,
325 North Front Street, Grand Rapids, Mich.



SAW FOR Cutting Hot Iron or Steel.

A. R. KING MFG. CO.,
ERIE, 11th & 12th Sts.,
JERSEY CITY, N. J.
MACHINERY AND TOOLS.
Heavy Machine Castings.

WORTHINGTON CONDENSERS.

AGGREGATING IN CAPACITY
276,320
HORSE POWER
ARE NOW IN USE.
SEND FOR SPECIAL PAMPHLET.

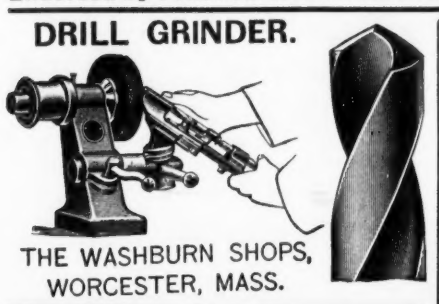
HENRY R. WORTHINGTON,
NEW YORK,
BOSTON, PHILADELPHIA, CHICAGO,
ST. LOUIS, DENVER.

Established in 1874.
CLEVELAND TWIST DRILL CO.
Corner Lake & Kirtland Sts., Cleveland, O.
100 & 102 Reade Street, New York.
85 Queen Victoria St., London, Eng.

GRAHAM TWIST DRILL AND CHUCK CO., DETROIT, MICH., U. S. A.
SOLE MANUFACTURERS OF
GRAHAM'S GROOVED SHANK TWIST DRILLS AND CHUCKS.

Endorsed by Practical Mechanics Everywhere. Send for Catalogue.

DRILL GRINDER.



THE WASHBURN SHOPS,
WORCESTER, MASS.

BROUILLARD & JONES TOOL CO.,
275 MAIN ST., SPRINGFIELD, MASS.
Dies, Punches and Special Tools,
ALSO EXPERIMENTING ON FINE MACHINES.
Estimates Given Freely.

THE PECK PATENT DROP PRESS
MINER & PECK M'F'G CO.
SUCCESSORS TO BEECHER & PECK
NEW HAVEN, CONN.
DROP FORGINGS

RADIAL DRILLS
2, 3 and 4 ft.
ARMS.
Patented Nov. 3, 1891.
A MODERN
TOOL.

14 in. x 6 ft.
ENGINE LATHE.
22 in. x 8 ft., 10 ft., 12 ft., 14 ft. x 16ft.
LATEST IMPROVED
ENGINE LATHES.
Address DIETZ, GANG & CO.,
58 and 60 Penn St., Cincinnati, O., U. S. A.

Paragon Drawing Instruments, Extra and Best Quality, German Drawing Instruments, Paragon, Duplex, Universal, Anvil Drawing, Helios, Blue Process Papers, Scales, Triangles, T-Squares, Slide Rules, Standard Profile and Cross-section Papers. Catalogue to professional people on application.

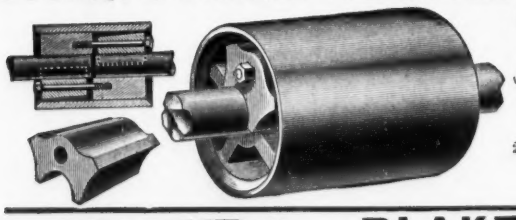
Deposited in the U. S $887,000.00.

Policies issued giving full protection to Employers against loss by Claims from Employes on account of Accident. Rates Proportioned to Risks of Occupation. One Premium the only Payment during year. No Contingent or other Liability on part of Employer.

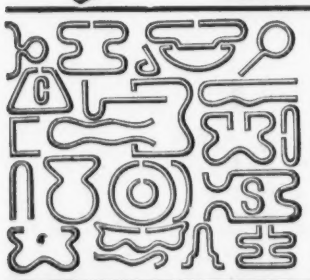
CHIEF OFFICE IN THE UNITED STATES:
71 KILBY ST., BOSTON, MASS.
ENDICOTT & MACOMBER,
Managers and Attorneys.

BOSTON: Samuel Appleton, 28 Central Street.
NEW YORK: Edmund Dwight, Jr., General Agent, 51 Cedar Street.
MIDDLE DEPARTMENT: Tattnall Paulding, Resident Adviser; W. A. L. LAUGHTON, Manager; John M. Ash, Jr., General Agent, 416 to 420 Walnut Street, Philadelphia.
CHICAGO: Geo. A. Gilbert, 226 and 228 La Salle Street.
ST. LOUIS: F. D. Hirschberg Bro., 130 N. Third Street.
AGENTS IN ALL THE PRINCIPAL CITIES.

STUART'S PATENT IMPROVED WEDGE COUPLING.

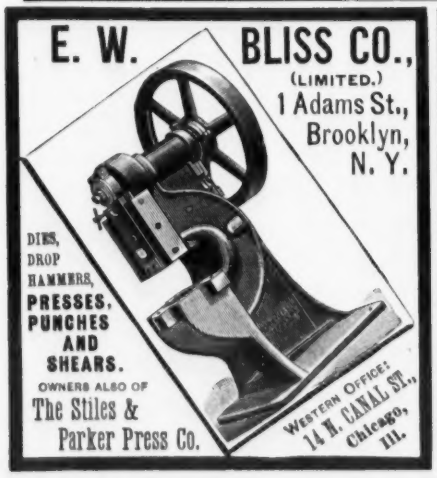


NO KEYS NOR KEY SEATING.
SENT ON TRIAL.
Can be attached or removed in a few seconds without injury to shaft or coupling.
SIMPLEST and BEST in MARKET, Also the Cheapest.
Send for discounts and illustrated Price List of 20 sizes.
ROBERT J. STUART,
NEW HAMBURGH, N. Y.



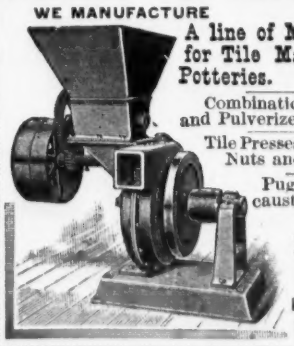
BLAKE & JOHNSON,
WATERBURY, CONN.
BUILDERS OF
SPECIAL AUTOMATIC MACHINERY
FOR WORKING
WIRE or SHEET METAL
INTO ANY SHAPE DESIRED.
BICYCLE MACHINERY A SPECIALTY.

E. W. BLISS CO.,
(LIMITED.)
1 Adams St.,
Brooklyn,
N. Y.



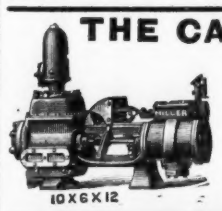
DIES, DROP HAMMERS, PRESSES, PUNCHES AND SHEARS.
OWNERS ALSO OF
The Stiles & Parker Press Co.
WESTERN OFFICE:
14 N. CANAL ST.,
Chicago, Ill.

ENCAUSTIC TILE MACHINERY.
WE MANUFACTURE
A line of Machinery for Tile Makers and Potteries.
Combination Crusher and Pulverizer.
Tile Presses with Steel Nuts and Screws.
Pug Mills, Encaustic Tile Dies, &c.
Hetherington & Berner,
INDIANAPOLIS
INDIANA.

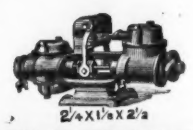


THE BUFFALO STEAM PUMP CO.,
MANUFACTURERS OF
BUFFALO, N. Y.
STEAM PUMPS
FOR ALL SERVICES.
NEW YORK OFFICE, 76 JOHN STREET.

THE CANTON STEAM PUMP CO., CANTON, OHIO.
MANUFACTURERS OF
STEAM PUMPS for EVERY PURPOSE.
BOILER FEEDERS A SPECIALTY.
NEW DESIGNS AND IMPROVEMENTS.
ABSOLUTELY FIRST CLASS.
Discounts and Terms on Application.

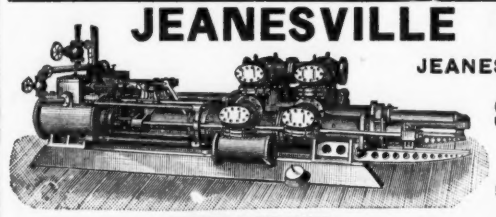


10 X 6 X 12



2¼ X 1⅞ X 2½

JEANESVILLE IRON WORKS,
JEANESVILLE, LUZERNE CO., PA.
BUILDERS OF
SPECIAL PUMPS OF ALL KINDS.
DUPLEX OR SINGLE,
SIMPLE OR COMPOUND.
MINE PUMPS, SINKING PUMPS, PRESSURE PUMPS, VACUUM PUMPS, ARTESIAN WELL PUMPS, POWER PUMPS, ETC., ETC.



DUPLEX MINE PUMP.

BALLS
For all Anti-Friction Purposes.
STEEL BALLS from ⅛" to 1"
READY FOR IMMEDIATE SHIPMENT.
Sizes up to 3" in a short time. Aluminoid hard as hardened tool steel all sizes above ½". Write for prices and samples.
GRANT ANTI-FRICTION BALL CO., Fitchburg, Mass.

"PRACTICAL DRAWING."
By J. G. A. MEYER.
This valuable series of 93 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies, 5 cts. each, postpaid.

Order now before our stock of papers is exhausted.
ADDRESS:
American Machinist,
203 BROADWAY,
NEW YORK.

"MODERN LOCOMOTIVE CONSTRUCTION."
By J. G. A. MEYER.
This valuable series of 106 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $5.30, or single copies, 5 cts. each, postpaid.

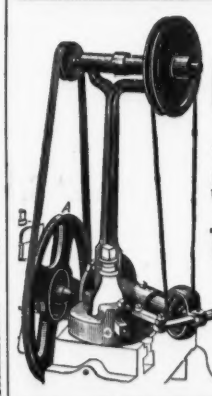
FOOT LATHE
SCREW CUTTING
ADDRESS FOR $40 CIRCULAR
NARRAGANSETT MAC. CO.
BOX 1008 PROVIDENCE, R. I.

SOMETHING NEW!
NICHOLSON'S COMPRESSION
SHAFT COUPLINGS
W. H. NICHOLSON & CO., Wilkes-Barre, Pa.

SEND FOR CATALOGUE.
WORCESTER MACHINE SCREW CO.

Manufacturers of Set, Cap & Machine Screws, Studs, etc.

W. C. YOUNG M'F'G CO., Worcester, Mass., Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, ETC.



LATHE
Center Grinder
For truing **Hardened** centers **in place.**
A cheap and effective tool, needed in every well-regulated machine shop.
Write for prices to
Trump Bros. Mach. Co.
Wilmington, Del.
FOR SALE BY
Chas. Churchill & Co. Ltd.,
21 Cross St., Finsbury,
London, England.

WIDE AWAKE AND
PROGRESSIVE MACHINISTS
always write for our Catalog before buying
TOOLS.
IT COSTS NOTHING.
STANDARD TOOL CO.,
ATHOL, MASS., U. S. A.

ALUMINUM!
THE COWLES ELECTRIC SMELTING & ALUMINUM COMPANY,
Lockport, - New York,
Offer Pure Aluminum in Ingots, Slabs, Sheet, Wire and Castings at lowest market rates.
Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze.

MOFFET PORTABLE DRILL.
UNSURPASSED AS A REAMER.
Will work in any position.
Weighs 42 lbs. and drills from ¾ to 1¼ inches diameter.
Runs with Steam —OR— Compressed Air.

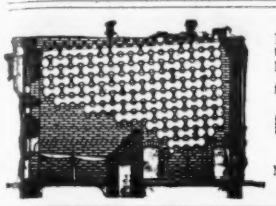
Send for Circular.
Manufactured by
J. G. TIMOLAT,
59 S. Fifth Ave.,
NEW YORK.

CHAS. A. STRELINGER & CO.,
Tools, Supplies and Machinery,
DETROIT, MICH.

P. H. & F. M. ROOTS,
Connersville, Indiana,
MANUFACTURERS OF
PORTABLE FORGES, TUYERE IRONS, ETC.

ROOTS' NEW ACME HAND BLOWERS
Slow speeded, Force-blast, Durable, Compact and Cheap.
Roots' Foundry Blowers, Gas Exhausters, etc.
S. S. TOWNSEND, Gen. Agt.
COOKE & CO., Selling Agts.
163 & 165 WASHINGTON ST., NEW YORK.

In Writing, Please Mention This Paper.



Absolute Safety from Destructive Explosion—Highest Attainable Economy of Fuel—Rapid Generation of Dry or Superheated Steam—Durability—Low Cost of Maintenance—Ease of Transportation and General Efficiency are among the advantages possessed by the "Wharton-Harrison" form of boiler.

Send for Descriptive Pamphlet—Drawings, Specifications, and Estimates promptly furnished for any amount of power from 4 H.P. up.

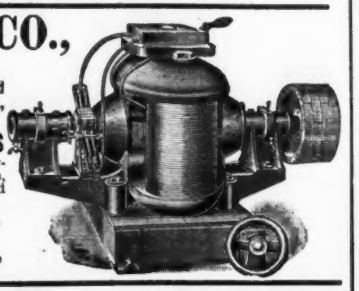
State requirements and consider our proposition.

HARRISON SAFETY BOILER WORKS,
PHILADELPHIA, PENNA.

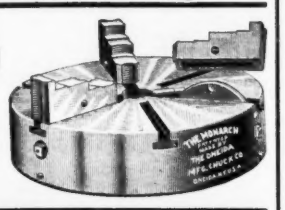
NEW YORK, N. Y. 41 Dey Street. | CHICAGO, ILL. 187 La Salle Street. | ATLANTA, GA. 9 No. Pryor Street.

THOS. H. DALLETT & CO.,
York Street & Sedgley Ave., Philadelphia.

Manufacturers of
Portable Drills, Hand Drills, Boiler Shell Drills, Light Drill Presses.
ELECTRIC MOTORS
Specially adapted for driving Machine Tools, Cranes, Elevators, Pumps, Presses and other Machinery.
ELECTRIC GENERATORS,
For installation of Complete Power Plants.

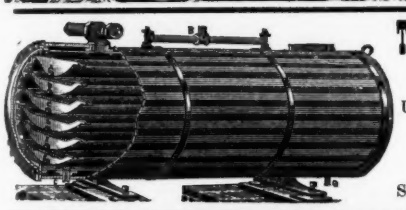


The ONEIDA MFG. CHUCK CO.,
ONEIDA, N. Y., U. S. A.
MANUFACTURERS OF
LATHE AND DRILL CHUCKS.



THE MONARCH CHUCK has the quickest reversing jaws ever invented. Single piece of metal in body. Patent V hole in nut pulls jaw close to face of chuck when gripping. Most durable and convenient chuck in the market. **Write for Catalogue.**

Norton Emery Wheel Co.
SEND FOR ILLUSTRATED CATALOGUE
Worcester, Mass.



The HOPPES Live-Steam Feed-Water Purifier,
Guaranteed to Prevent Scale in Boilers.
Using any kind of water. Hard Sheet Steel Troughs.
Easily Cleaned.
HOPPES MANUFACTURING CO.,
Send for Catalogue D. SPRINGFIELD, OHIO.

CRANES, PORTABLE HOISTS, OVERHEAD TRACK TROLLEYS.
SEND FOR CATALOGUE.

MARIS AND BEEKLEY,
2343 & 2345 Callowhill St., PHILADELPHIA, PA.

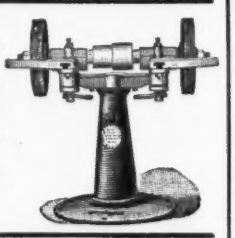
HIGH SPEED POWER

TRAVELING CRANES.
DRIVEN BY ROPE OR ELECTRIC MOTOR.
MANUFACTURED BY
ALFRED BOX & CO.,
Front, Poplar and Canal Sts.
PHILADELPHIA, PA.
Send for Circulars and References.

GRINDING MACHINERY

PRICES ON APPLICATION.
THE HORNER MACHINE CO.,
HOLYOKE, MASS.
Water Tool Grinder.

McGRATH'S PATENT
Emery Grinding, Polishing and Buffing Machines.
Bearings yielding or rigid at will
Wheels *always true and in balance*, dispensing with use of diamond tool and chilled burr, and saving the time, labor, and cutting away of wheels, *otherwise wasted in truing*. Send for Catalogue.
McGRATH & COLLINS,
COHOES, N. Y.

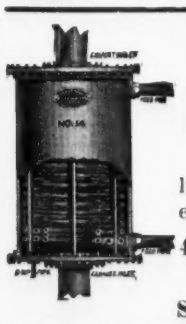


BOSTON GEAR WORKS,
35 Hartford St., Boston, Mass.
HEADQUARTERS for GEARS.

1892 Catalogue.
80 Illustrations.
Price, 10 cents.

FREE
INTERESTING, INSTRUCTIVE.
Our new pamphlet on lubricating by means of Pure Flake Graphite. Send for a copy.
JOS. DIXON CRUCIBLE CO.,
JERSEY CITY, N. J.

THE NATIONAL
Feed-Water
HEATER.

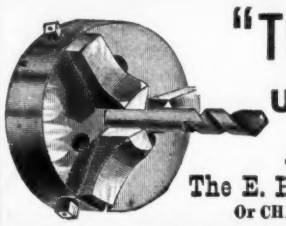


A brass coil Heater delivering water to the boiler at 210° Fahrenheit.
400,000 Horse power sold. Prices Low. Satisfaction universal.
THE NATIONAL PIPE BENDING CO.,
82 River Street, NEW HAVEN, CONN.

Westcott Chuck Co., Formerly **Oneida Steam Engine & Foundry Co.,** **Oneida, N.Y., U.S.A.**
Manufacturers of all kinds of
LATHE AND DRILL
CHUCKS.
Send for Illustrated Catalogue.

Under Westcott's Patent.
Capacity Little Giant Improved.

No.	Diameter.	Holding Drills.
00	1¼ inch.	0 to ¼ inch.
0	2⅛ "	0 to ½ "
1	3 "	0 to ⅝ "
2	3¼ "	0 to 1 "
2½	4 "	0 to 1 in., ex strong.
3	6 "	0 to 1⅛ inch.
4	6½ "	0 to 2 "

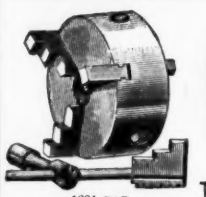


"THE HORTON LATHE CHUCK."
MORE THAN 300 SIZES AND STYLES. COMPRISING
Universal Chucks, Independent Chucks, Combination Chucks,
Of Every Description. Send for 52 page Illustrated Catalogue.
The E. HORTON & SON CO., Windsor Locks, Conn., U. S. A.
Or CHAS. CHURCHILL & CO., Ltd., 21 Cross St., Finsbury, London, Eng.

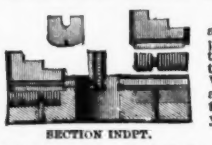
NOTICE

We have just added to our line of patent Face-Plate Jaws an 8 inch. We now carry in stock three sizes—8 inch, 10 inch and 12 inch.

Send for new Catalogue of Chucks to
THE CUSHMAN CHUCK CO.,
HARTFORD, CONN.

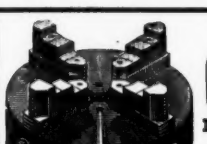

1884 PAT.

FEQ DRILL.


SECTION INDPT.

LATHE AND DRILL CHUCKS.
Buyers should note quality first and then price. We have made improvements which greatly increase the durability and accuracy of our tools. Please investigate our claims. We carry a large variety in stock, and design chucks and chucking tools for special purposes. Have you read our late catalogue?
THE D. E. WHITON MACHINE CO., 5 Oak St., New London, Conn., U.S.A.
OR SELIG, SONNENTHAL & CO., 85 QUEEN VICTORIA ST., LONDON, E. C., ENGLAND.

CHUCKS
ALL STYLES.
NEW REVERSIBLE JAWS (DOVETAILED).
'92 Catalogue Now Ready.
THE HOGGSON & PETTIS MFG. CO.,
Est. 1849. NEW HAVEN, CONN.

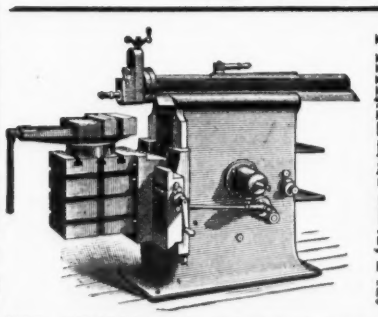


SKINNER CHUCKS
Independent, Universal and Combination LATHE CHUCKS.
—Also, DRILL CHUCKS.—
Send for CATALOGUE.
SKINNER CHUCK CO.
NEW BRITAIN, CONN.

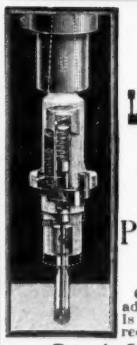
POSITIVE DRIVING DRILL CHUCK.
For either straight or taper Shank Drills.

Has the Holding Power of Taper Socket together with all the advantages of the common Friction Chuck. Write for Illustrated Price List and Discounts to
THE PRATT CHUCK CO.,
Clayville, N. Y., U. S. A.

Chucks The **NATIONAL.**
INDEPENDENT, UNIVERSAL, COMBINATION.
Strongest. Easiest to change. Best finish. **Reversible Jaws** (patented) giving 5 changes including every possible desired position. NEW CATALOGUE, illustrated, sent free. Liberal discounts. Prompt shipment. Address
WM. WHITLOCK, MANUFACTURER,
132d Street and Park Ave., New York City.



Office and Works, 23d and Filbert Streets, PHILADELPHIA, PA.
THE HENDERSON MACHINE TOOL CO.
MANUFACTURERS OF
Sheet Metal Presses, Shears, Tools, Etc.
Machinists' Shapers, Milling Machines
AND SPECIAL MACHINES.
Correspondence solicited.



DO YOUR
TAPPING
WITH THE
Leland Tapping Attachment,
BUILT BY
HAMPDEN TOOL CO.,
HOLYOKE, MASS.
PRICES REDUCED.
DOES NOT BREAK TAPS.
Can be operated by any one. Requires no adjustment from one size of tap to another Is free from all adjustable frictions, &c., that require scientific treatment continually.
Send for Circular.

BEVEL GEARS,
Cut Theoretically Correct.
For particulars and estimates apply to
HUGO BILGRAM,
MACHINIST,
Successor to
BREHMER BROS.,
440 N. 12th St., Philadelphia, Pa.

Pawling & Harnischfeger
Milwaukee, Wis.

Horizontal Drill and Boring Tools.
Column Facing Lathes.
Pit Lathes.
Truck Wheel Grinders.
Boring Bars, &c.
Electric, Steam and Hand Cranes.

Low Jack.

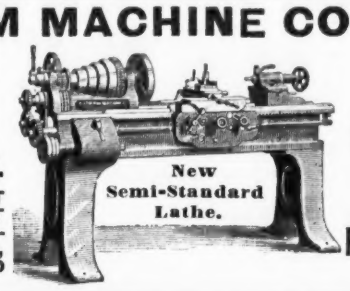
HYDRAULIC MACHINERY
PRESSES, PUMPS, PUNCHES,
JACKS, VALVES, FITTINGS,
PACKINGS,
ACCUMULATORS.
Watson & Stillman, Mfrs.
204, 206, 208 & 210 E. 43d St., New York.

Plain Press.

PUTNAM MACHINE COMPANY,

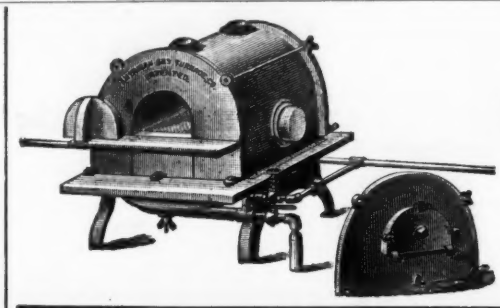
ORIGINAL BUILDERS OF **PUTNAM AUTOMATIC ENGINES.**

IRON PLANERS, BOLT CUTTERS, UPRIGHT DRILLS, MILLING MACHINES, SHAPERS, SLOTTERS, RAILROAD TOOLS, ETC.



STANDARD AND SEMI-STANDARD LATHES.

FITCHBURG, - MASS., U. S. A.



American Gas Furnace Co.

Designers and Manufacturers

GAS BLAST FURNACES.

Send for Catalogue. Estimates made for any mechanical operation requiring **high, even** and **controllable temperature.**

No. 80 NASSAU STREET, NEW YORK.

SENSITIVE BENCH DRILLS.

JOHN A. MILLIKEN, SUCCESSOR TO MILLIKEN & D'AMOUR, Cor. John and Dutch Sts., NEW YORK CITY.

For producing high grade work at low cost, designed and built to order.

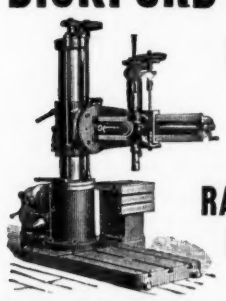
CHURCHILL & CO., Agents. LONDON, ENG.

THE STANDARD TOOL CO., Cleveland, Ohio.

Manufacturers of STRAIGHT-LIP INCREASE **TWIST DRILLS**

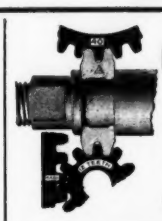
SOLID AND SHELL REAMERS, MILLING CUTTERS, TAPS, SOCKETS, "STANDARD" TWIST DRILL GRINDING MACHINE CHUCKS AND SPECIAL TOOLS.

BICKFORD DRILL CO.



BUILDERS OF **UPRIGHT RADIAL AND UNIVERSAL RADIAL DRILLS.** BORING and TURNING MILLS.

3 PIKE STREET, CINCINNATI, O.



CLOUGH'S Combination Gear Cutters.

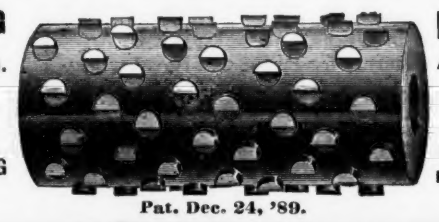
One pair cuts a pitch from 12 teeth to a rack. These Cutters are made double or a solid single cutter; also to mill tops of teeth at one operation, thereby saving turning blanks. Kept in stock. Shipped promptly. Special work to order. Circular and prices of

R. M. CLOUCH, TOLLAND, CONN.

THE INGERSOLL MILLING MACHINE CO., Rockford, Ills., U. S. A.

SLAB MILLING MACHINES 36 in. Square, weighing 22,000 lbs.

Newly Designed HORIZONTAL BORING **MACHINES.**



Pat. Dec. 24, '89.

MILLING CUTTERS, ANY WIDTH OF FACE, ANY DIAMETER, FOR MILLING STRAIGHT FACE OR IRREGULAR SHAPED WORK.

UNIVERSAL AND RADIAL DRILLS.
REDUCED PRICES
ADDED (1892) FEATURES.
STYLES AND SIZES UNEQUALLED.
RIGHT IN DESIGN, MATERIAL, WORKMANSHIP.
CAPACITY OF WORKS 240 YEARLY
-WRITE US FOR INFORMATION-
THE UNIVERSAL RADIAL DRILL COMP'Y
CINCINNATI. O. U.S.A.

NEW CATALOGUE NOW READY, 300 PAGES. Wood-Working Machinists. LARGEST LINE in the U. S. Any Want Supplied. Superior for Efficiency and Merit.

PATTERN AND Flask Making Machinery

ONE OF OUR SPECIALTIES.

COLLEGE OUTFITS A LEADER.

THE EGAN CO.,

239 to 259 W. FRONT ST., Cincinnati, Ohio, U. S. A.

J. A. FAY & CO. CINCINNATI, OHIO, U.S.A.

BUILDERS OF IMPROVED

WOOD-WORKING MACHINERY

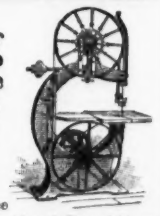
FOR USE IN

Pattern Making

Car, Locomotive and Bridge Works, Planing Mills, Sash, Door and Blind Factories, Cabinet, Spoke and Wheel Shops, Carriage Works, &c., &c.

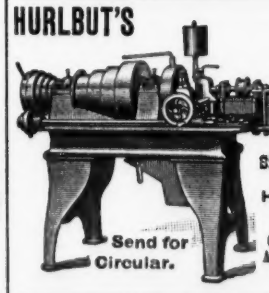
All of the highest standard of excellence

W. H. DOANE, Pres. D. L. LYON, Sec'y.



No. 1 Band Saw

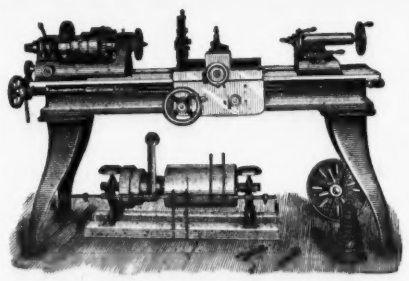
HURLBUT'S Patent Cutting-off and Centering Machine.



Sizes. 2", 3", 4", 5", 6"

MADE BY HURLBUT, ROGERS MACHINE CO. South Sudbury, Mass.

Chas. Churchill & Co., Ltd Agents, 21 Cross St., London, England.

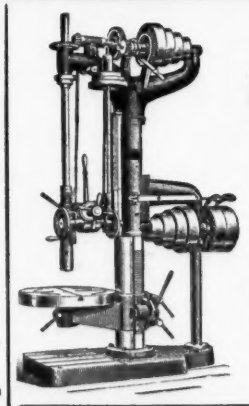


A. FALKENAU,

11th Street & Ridge Ave., Philadelphia, Pa.

MANUFACTURER OF SUPERIOR 14-INCH LATHES, TOOL GRINDING MACHINERY, TRAVELING CRANES, ETC.

Special Machinery designed and constructed.



HAMILTON MACHINE TOOL CO.,

N. E. Cor. Water & Market Sts., Hamilton, Ohio, U. S. A.

MODERN

26" and 32" Back Geared and Power Feed

DRILL PRESSES

A SPECIALTY.

Correspondence Solicited.

SAW TABLES FOR PATTERN MAKERS.

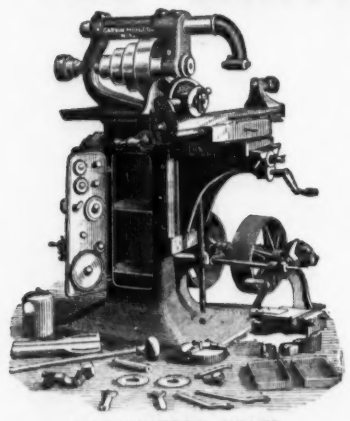
ROYLE MACHINE WORKS, PATERSON, N. J.

Pat. KEY-SEAT SETTING GAUGE

PATENT UNIVERSAL DEPTH, ANGLE AND SCREW-CUTTING CENTER **TWIST DRILL GAUGE**

J. WYKE & CO Pipe Machinists' Tools E. BOSTON, MASS. Send for LISTS

THE GARVIN MACHINE CO.,



NO. 1 UNIVERSAL MILLER.

MANUFACTURERS OF AND DEALERS IN

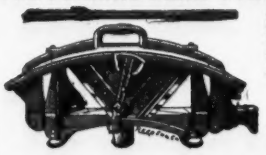
MILLING MACHINES,
SCREW MACHINES,
TAPPING MACHINES,
HAND LATHES,
CUTTER GRINDERS,
DRILL PRESSES,
ENGINE LATHES,
PLANERS, SHAPERS,
POWER PRESSES, Etc.

SPECIAL MACHINERY DESIGNED AND BUILT.

A Full Stock of New and Second-Hand Machinery Always on Hand at our Warerooms.

LAIGHT AND CANAL STS., NEW YORK.

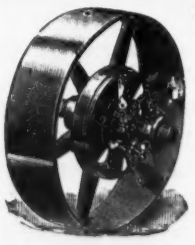
THE PERKINS DRAW STROKE TRIMMER,



An Indispensable Tool for all Bench Woodworkers. Latest and Best Design. Infringers Prosecuted. Trial, not orders, solicited.

PERKINS & CO., Grand Rapids, Mich.

STOCKS, NEAVE & CO., Manchester, England.



The Moore & White Co.,

15th St. & Lehigh Ave., PHILADELPHIA, PA.

MFRS. OF The "Moore & White" **Friction Clutches** AND **Cut-off Couplings.**

Send for Circulars.

THE McNAULL UNIVERSAL RADIAL DRILL.

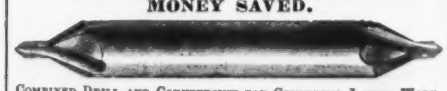
Patented.

BEST THING OUT.

Write for circulars to

McNAULL Mach. & Fdy. Co., RONCEVERTE, W. VA.

MONEY SAVED.



COMBINED DRILL AND COUNTERSINK FOR CENTERING LATHE WORK

Size of body 3-10 in.; Drills ¼ in. and 3-32, or same size each end.
" " 15-64 in.; " 8-100 and 7-100.
" " 13-64 in.; " 1-16 inch. Price $1.50 per doz.

J. T. SLOCOMB & CO., Providence, R. I.

MORSE TWIST DRILL AND MACHINE COMPANY,

Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.** New Bedford, MASS.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

F. E. REED & CO.,
Worcester, Mass.
MANUFACTURE
ENGINE LATHES
HAND LATHES, FOOT LATHES AND MILLING MACHINES.
Manning, Maxwell & Moore,
Selling Agents, 111 Liberty St., New York.
515 Phenix Building, Chicago.

OUR SPECIALTY
CRANK and GEARED SHAPERS.
J. STEPTOE & CO., Cincinnati, O.
Geo. Place Machine Co., Agents, New York.

NOTICE.

REDUCTION IN PRICE OF
50, 60 AND 72 INCH
BORING AND TURNING MILL.
Write for New List, August 1st, 1892.
H. BICKFORD, - Lakeport, N. H.

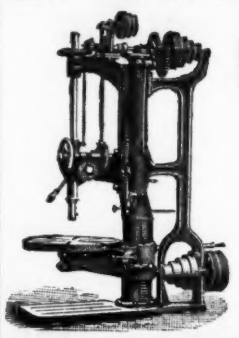
PLAIN MILLING MACHINES

SOMETHING NEW.

The Cincinnati Milling Machine Co.,
CINCINNATI, OHIO.

NEW HAVEN MANUF'G CO.,

New Haven, Conn.



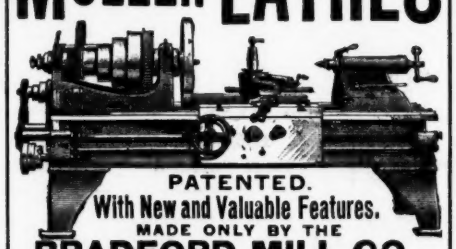
Lathes, Planers, Shapers, Slotters, Etc.

---

2 BY 24 FLAT TURRET LATHE.

Send for CATALOGUE for '92.
JONES & LAMSON MACHINE CO.,
Springfield, Vt., U. S. A.

MULLER LATHES



PATENTED.
With New and Valuable Features.
MADE ONLY BY THE
BRADFORD MILL CO.,
8th and Evans, CINCINNATI, O.
London House: CHAS CHURCHILLL & CO., L't'd.
21 Cross St., Finsbury, London, E. C., Eng.

GAGE MACHINE WORKS,

FOX & TURRET LATHES A SPECIALTY.

MANUFACTURERS OF
MACHINE TOOLS,
WATERFORD, N. Y.

IRON PLANERS.

Extra Heavy. Latest Design. All Modern Improvements.

L. W. POND MACHINE CO., WORCESTER, MASS.

D. SAUNDERS' SONS,

21 ATHERTON ST., Yonkers, N. Y.
MANUFACTURERS OF

Steam & Gas Fitters' Hand Tools.
Pipe Cutting, THREADING, AND **Tapping Machines.**
SEND FOR CIRCULAR.

THE PATENT WHEEL PIPE CUTTER shown in the cut combines simplicity with strength and lightness. Easily adapted to various sizes of pipe. Rolling instead of sliding motion. No loose parts to become detached and mislaid. All wearing surfaces are of tool steel hardened. Less friction of parts than any other pipe cutter made.

SIX SPINDLE TURRET DRILLS
For Sale by
A. O. QUINT, HARTFORD, CONN.

BOYNTON & PLUMMER,

WORCESTER, MASS.
Manufacturers of
Shaping Machines, Drilling Machines, Bolt Cutting Machines.
CHAS. CHURCHILL & CO., Lt'd, Agents.
21 Cross St., Finsbury, London, England.

BARNES' WATER EMERY TOOL GRINDER

Has no pumps, no valves. No piping required to supply it with water. Always ready for use. Simplest in construction, most efficient in operation. Send for Catalogue and Prices.
W. F. & John Barnes Co.
1995 RUBY ST.,
ROCKFORD, ILL
ENGLISH AGENTS,
CHAS. CHURCHILL & CO., LTD.
21 CROSS ST., FINSBURY, LONDON, E. C., ENG.

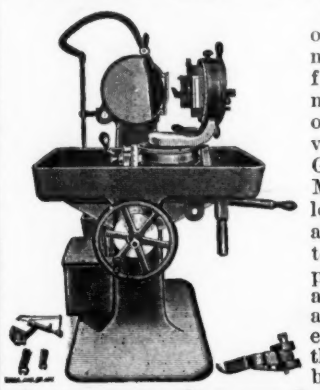
BARKER'S IMPROVED CENTER GRINDING MACHINE.

Price, $10. NO GAUGES. NO BELT.
Every Machine Guaranteed.
MANUFACTURED BY
WM. BARKER & CO., Cincinnati, Ohio.
SEND FOR CIRCULAR.

FOR
Substantial, Well Made, Low Price, Patented,
20 Inch Drills,
With latest improvements, Lever, Combination or Wheel Feed, address
Sibley & Ware,
SOUTH BEND, - INDIANA

VERTICAL DRILL PRESSES, 12 to 52 inch swing. Radial Drills, 4 to 10 ft. swing. Boiler Makers' Drills, Bridge and Ship Builders' Drills, Gang Drills, and other Drilling Machinery. Engine Lathes, 12 to 24 in. swing. Send for Catalogue.
PRENTICE BROS.,
WORCESTER, MASS.

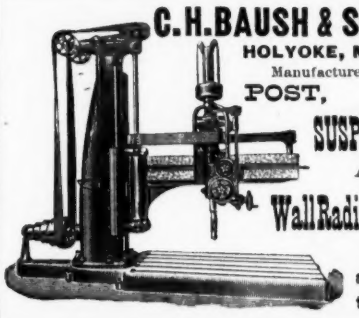
REDUCED PRICE.



On account of the economy resulting from the manufacture of our Universal Tool Grinding Machine in lots of 50, we are enabled to reduce the price materially while adding to the efficiency of the machine by supplying all attachments. SEND FOR CIRCULAR.
GISHOLT MACHINE CO., Madison, Wis.

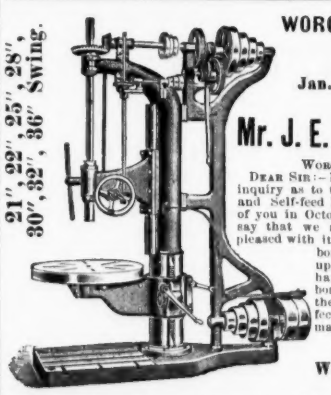
C. H. BAUSH & SONS,

HOLYOKE, MASS.
Manufacturers of
POST,



SUSPENDED AND **Wall Radial Drills**
From the smallest to the largest.

WORCESTER, MASS.
Jan. 26, 1891.



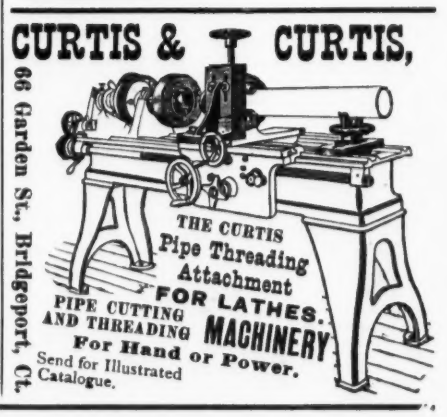
24", 28", 30", 32", 36" Swing.
24", 28", 30", 32", 36"

Mr. J. E. SNYDER,

WORCESTER, MASS.
DEAR SIR:—In reply to your inquiry as to the 25 in. R. G. and Self-feed Drill purchased of you in October last, would say that we are very much pleased with it. We got it to bore out and face up small cylinders having a 4 5-8 in. bore, and it is doing the work in a perfectly satisfactory manner.
Yours, &c.,
W. C. YOUNG.

CURTIS & CURTIS,

66 Garden St., Bridgeport, Ct.



THE CURTIS Pipe Threading Attachment FOR LATHES.
PIPE CUTTING AND THREADING MACHINERY For Hand or Power.
Send for Illustrated Catalogue.

W. D. FORBES & CO.,
ENGINEERS,
HOBOKEN, N. J.
14TH STREET FERRY.

WE DESIRE TO CONTRACT FOR FINE MACHINE WORK.

WE MAKE MILLING CUTTERS AND CARRY REGULAR SIZES IN STOCK.

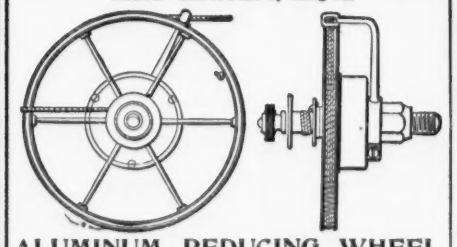
Maule's "Skeleton" Pipe Die

is Manufactured by PANCOAST & MAULE, Philadelphia, U. S. A.

is a **Skeleton** *in construction, a* **Giant** *in efficiency, an* **Infant** *in price.*

Ask your jobber for full particulars of it, and if he cannot give you the desired information, we shall be most happy to do so. If you use any Pipe Dies, this one is a tool far too good and cheap for you not to know all about it.

TO OBTAIN AN ACCURATE CARD WITH AN
INDICATOR
It is necessary to use a perfect method of reducing the motion. This is done by using our



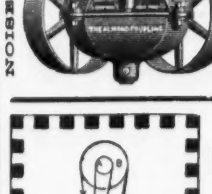
ALUMINUM REDUCING WHEEL
Lightest and only Perfect motion made. For circulars and prices address WEBSTER & PERKS TOOL CO.,
Cor. Spring & Monroe Sts., Springfield, Ohio, U. S. A.

PRESSES, DIES AND OTHER
SHEET-METAL TOOLS
FERRACUTE MACHINE CO. BRIDGETON, N. J. U.S.A.

SOFT GRAY IRON CASTINGS.

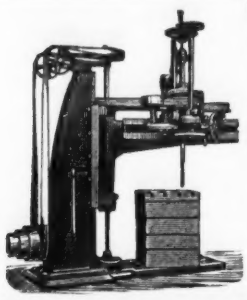
From ½ oz. to 1000 lbs. Small Castings a Specialty. Light machinery wanted to build.
ONTARIO IRON WORKS
CANANDAIGUA, N. Y.

"SELF-EXTENSION"



The Almond Coupling
A NEW quarter turn motion to replace quarter turn belts and bevel gears.
T. R. ALMOND, MFR.,
83 and 85 Washington Street,
BROOKLYN, N. Y.

HOME STUDY OF
MECHANICS
To commence, students only need to know how to read and write.
Send for **FREE** Circular to **The Correspondence School of Mechanics,** Scranton, Pa.



WM. SELLERS & CO., Incorporated.

PHILADELPHIA, PA.

MANUFACTURERS OF

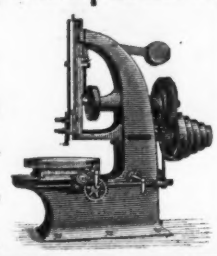
MACHINE TOOLS,

TRAVELING CRANES AND SWING CRANES,

Operated by Electricity, Shafts or Independent Engines.

Turn Tables, Testing Machines, Shafting, Pulleys, Hangers, Couplings, Etc.

INJECTORS FOR ALL CLASSES OF BOILERS.



BEMENT, MILES & CO., Philadelphia, Pa.

BUILDERS OF

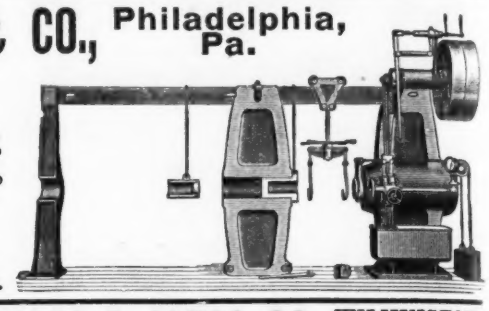
METAL-WORKING

Machine Tools

FOR RAILROAD SHOPS, LOCOMOTIVE AND CAR BUILDERS, MACHINE SHOPS, ROLLING MILLS, STEAM FORGES, SHIP YARDS, BOILER SHOPS, BRIDGE WORKS, ETC.

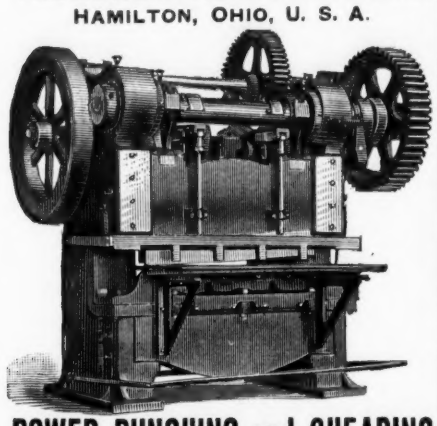
New York Office, Equitable Building.

GEORGE PLACE, Agent.



THE LONG & ALLSTATTER CO.

HAMILTON, OHIO, U. S. A.



POWER PUNCHING and SHEARING MACHINERY.

For Ship Builders, Boiler Makers, Bridge Works, Architectural Iron Works, Carriage and Wagon Makers, Agricultural Implements, etc., etc.

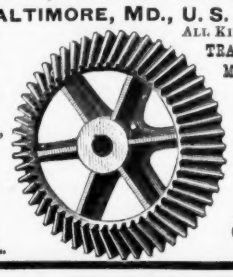
Correspondence stating requirements solicited.

Robert Poole & Son Co.,

ENGINEERS, FOUNDERS & MACHINISTS,

BALTIMORE, MD., U. S. A.

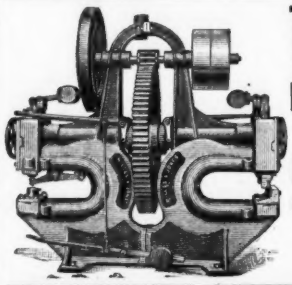
MACHINE MOLDED AND PLANED GEARING of All Kinds, SPUR, BEVEL, MITRE, MORTISE, ANGLE, HELICAL, WORM, INTERNAL.



ALL KINDS OF TRANSMISSION MACHINERY OF THE HEAVIEST CLASS.

Catalogues and Estimates Furnished.

Correspondence Solicited.



The HILLES & JONES CO., WILMINGTON, DEL.

MANUFACTURERS OF

PUNCHES AND SHEARS,

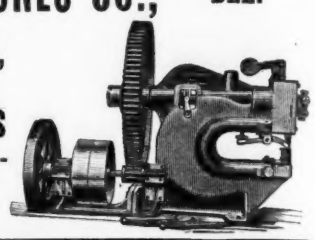
All Designs and Sizes,

AND A FULL LINE OF

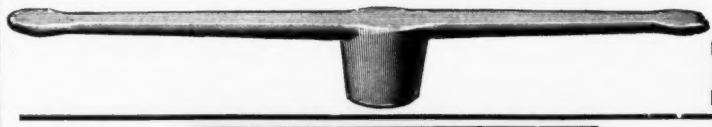
MACHINE TOOLS

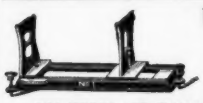
FOR

Boiler Makers, Bridge Builders, Ship Builders, Railroad Shops, Locomotive and Car Builders, etc., etc.



WYMAN & GORDON, WORCESTER, MASS. **DROP FORGINGS**





Bowsher's BALANCING **WAY**

FOR BENCH AND FLOOR USE. 8 SIZES AND STYLES.

A new idea. A time saver. A tool to take the place of the devices in present use for balancing pulleys, armatures, cutter heads and rotary parts of machinery in general Ways are *chilled* and *ground*. Spirit levels attached. Substantial, accurate, cheap. Send for circular.

N. P. BOWSHER, South Bend, Ind.

WRITE FOR CATALOGUE.
The Champion Forge Co.
Blower & Exhaust
MANUFACTURERS OF
STEEL PRESSURE BLOWERS, FAN BLOWERS, EXHAUST FANS, LEVER & CRANK BLOWERS, PORTABLE FORGES, TUYERE IRONS & STOCKS, BLACKSMITH DRILLS.
LANCASTER, PA. U.S.A.

THE OPEN SIDE IRON PLANERS.

THE DETRICK & HARVEY MACHINE CO., Baltimore, Md.

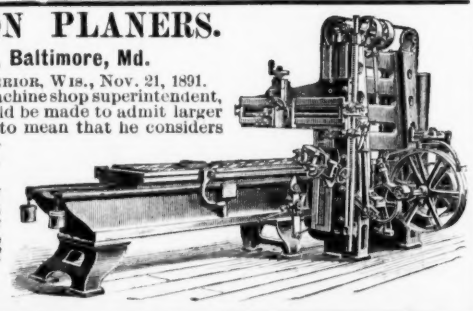
WEST SUPERIOR, WIS., Nov. 21, 1891.

DEAR SIRS: In answer to your inquiry, our machine shop superintendent, Mr. Street, suggests that your tool-posts should be made to admit larger steel, a criticism which might be interpreted to mean that he considers the machine generally to be strong enough to endure heavier work than the tool will now stand.

* * * * * *

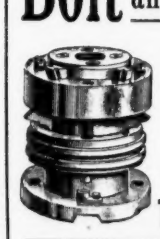
We have found it extremely useful and very handy. It has several times helped us out with work which could not have been handled by any other planer at the head of the Lake. We hope to possess ourselves of another one of larger size one of these days.

Very truly yours, W. F. MATTES, G. M.
WEST SUPERIOR IRON & STEEL CO.



Bolt and Nut Machinery.

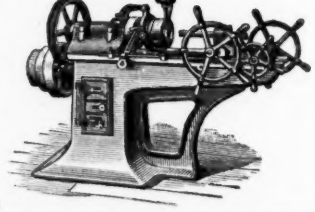
Catalogue on Application.



Complete Outfits for Bolt and Car Shops.

Bolt Cutters, Bolt Pointers, Upsetters and Benders, Bolt Headers, Nut Tappers, Nut Machines, Washer Machines, Car Link and Pin Machinery.

The National Machinery Co., Tiffin, O.



ACME MACHINERY CO.

CLEVELAND, OHIO.

Manufacturers of

ACME BOLT & RIVET HEADERS,

Acme Single & Double Automatic BOLT CUTTERS.

Cutting from 1-8 in. to 6 in. diameter.

Also SEPARATE HEADS and DIES.

FIRST PREMIUM, CINCINNATI CENTENNIAL.

PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.

Stover Friction Drill.

FOR

Light, Sensitive and Rapid Drilling.

The principal feature of this drill is, the power is greatest when speed is slow and large drills are used, and most sensitive for small drills under high speed. A very valuable feature never before attained in a Sensitive Drill. By this great advantage we more than double our working power.

Fitted also for bench and post.

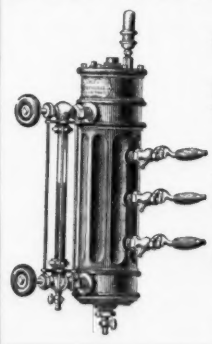
Send for Price and Circular.

STOVER NOVELTY WORKS,

23 River Street,

FREEPORT, ILL.

LOW WATER ALARM



Protect your Boilers and your Lives.

Burn less coal, and have the satisfaction of feeling safe, by using

ASHLEY'S ALARM.

It will prove a good investment.

Ashley Engineering Co.,

136 Liberty Street,

NEW YORK CITY.

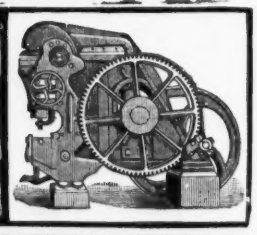
Agents wanted in every State.

PUNCHING AND SHEARING MACHINERY

AND BOILER MAKERS ROLLS.

NEW DOTY MANUFACTURING CO.

JANESVILLE WISCONSIN.



BRISTOL'S

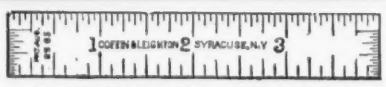
Recording Pressure Gauge

Makes continuous record DAY and NIGHT of all KINDS and all RANGES OF PRESSURE.

Low in Price and Guaranteed.

Send for Circulars and fac-simile Chart.

THE BRISTOL'S MFG. CO.,
WATERBURY, CONN.



MACHINISTS' SCALES,

PATENT END GRADUATION

We Invite Comparison for Accuracy with all others.

EVERY SCALE GUARANTEED. SEND FOR LIST.

COFFIN & LEIGHTON, SYRACUSE, N. Y

THE STANDARD REVOLUTIONS COUNTER

A. B. PITKIN MACHINERY CO.

PROVIDENCE, R. I BOSTON, MASS.

Send for Circular.

Patent Stop Motion. Registers 2,000 Revolutions

American Standard Gauge & Tool Works,

WILMINGTON, DEL.

Makers of Implements for Standard Measurements.

Crescent Gauge.

Flat Bar Gauge.

JAS. A. TAYLOR & CO.

The Morton Key-Seating Machine

THE LEADER.

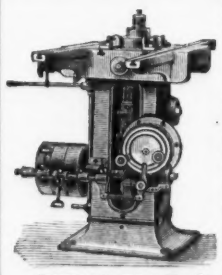
With recent patented improvements we guarantee to do the following class of work.

To cut key-ways through 1¼-inch hole in hubs or sleeves 23 inches long, in iron, brass or steel, also make it dovetail to insert feather key.

Will cut through 4-foot hub, through 5-inch hole. Our new centering chuck and setting attachment the work can be set exactly, without the use of a scale or rule. Our new binding attachment saves three-fourths of the time used on any other machine for binding work on. Our machine will cut a key-way and make a key to fit it.

For particulars address THE MORTON M'F'G CO., MUSKEGON HEIGHTS, MICH.

GIANT KEY SEATER.



Rack-Cutting Attachment Key-making Machines.

VALLEY MACHINE CO.
SAGINAW, MICH.

The Falls Rivet & Machine Co., of Cuyahoga Falls, O., have a Key Seater made by another firm, say the Giant is the best Key Seater on the market. The Marinette Iron Works at West Duluth, experienced with other Key Seaters, say the Giant is superior in every respect. L. H. Brightman, Pres. Brightman Machine Co., Cleveland, Ohio, says he is personally familiar with the principal Key Seaters, and that the Giant leads them all.

LONDON AGENTS: Charles Churchill & Co., Limited, 21 Cross st., Finsbury, E. C.

UNIVERSAL TRIMMERS for PATTERN MAKING.

ALL SIZES AND STYLES, NEW AND SECOND-HAND.

Each Machine inspected, and guaranteed to be in perfect working order, before shipment.

RANGING IN PRICE FROM $10.00 UPWARDS.

S. L. CROCKETT, Mfrs. Agent,

BOX 138. DETROIT, MICH

THE ERIE KEY-SEATING MACHINE.

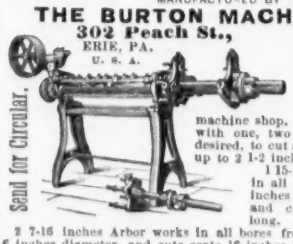
MANUFACTURED BY

THE BURTON MACHINE CO.,

302 Peach St.,

ERIE, PA. U. S. A.

Send for Circular.



The cut represents our Stationary and Portable Key-Seating Machine, which fully meets all the requirements of a machine shop. They are furnished with one, two or three Arbors, as desired, to cut any width of key-seat up to 2 1-2 inches wide.

1 15-16 inches Arbor works in all bores from 1 15-16 inches to 3 inches diameter, and cuts seats 12 inches long.

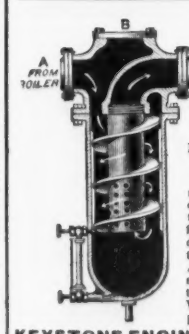
2 7-16 inches Arbor works in all bores from 2 7-16 inches to 6 inches diameter, and cuts seats 16 inches long.

4 7-16 inches Arbor works in all bores from 4 7-16 inches to 14 inches diameter, and cuts seats 26 inches long.

With an attachment for the purpose seats can be cut in holes as small as 1 inch diameter, by one passage of the cutter.

If the work is heavy and too large to be placed on machine it can be detached from stand and used as portable machine.

DRY STEAM.



Simpson's Centrifugal Steam Separator.

For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.

Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.

KEYSTONE ENGINE AND MACHINE WORKS,

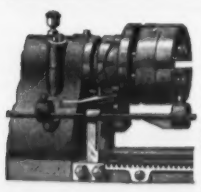
Fifth and Buttonwood Streets, Philadelphia,

Or, A. T. ARTHUR, Selling Agent, 18 Cortlandt St., N. Y.

ADAMS

Automatic Bolt-Threading & Nut Tapping Machine.

Made in all Sizes to Cut from 1-4" to 6".

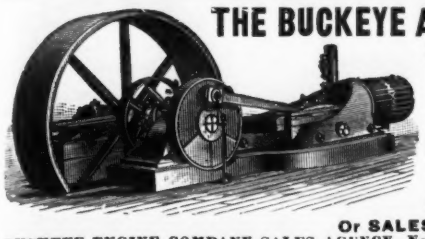


The simplest and most durable machine in existence. The threading head is made entirely of steel. No links, levers, springs, caps, cases, blocks or die rings in or about the head. Separate Heads and Dies Furnished. Write for descriptive circular and price list to

Capitol Mfg. Co., 125 to 137 Rees St., Chicago, Ill., U. S. A.

Agents for Great Britain, CHARLES CHURCHILL & CO., Ltd., 21 Cross Street, Finsbury, London, E. C., England.

THE BUCKEYE AUTOMATIC CUT-OFF ENGINES.



SLOW SPEED, MEDIUM SPEED AND HIGH SPEED ENGINES,

Simple, Compound and Triple-Expansion Engines.

HIGH-PRESSURE BOILERS.

Complete Steam Power Plants of Highest Attainable Efficiency.

Address BUCKEYE ENGINE CO., Salem, O.

Or SALES AGENTS:

BUCKEYE ENGINE COMPANY SALES AGENCY, No. 10 Telephone Building, New York City.
A. A. HUNTING, John Hancock Bld'g, Boston, Mass. N. W. ROBINSON, 97 Washington St., Chicago, Ill.
ROBINSON & CARY COMPANY, St. Paul, Minn. A. L. FISH, No. 61 First St., San Francisco, Cal.
A. M MORSE, 511 Commercial Building, St. Louis, Mo. J. M. ARTHUR & CO., Portland, Oregon.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton) Eastern Pennsylvania, Delaware, Maryland, and Virginia.

ALBANY STEAM TRAP CO., ALBANY, N. Y.

RETURN STEAM TRAPS, SPECIAL

BOILER FEED PUMPS

AND

PUMP GOVERNORS.

AUTOMATIC

STEAM PUMPS

AND GOVERNOR COMBINED

FOR PUMPING

HOT CONDENSED WATER.

Renewable Seat and Disc

VALVES.

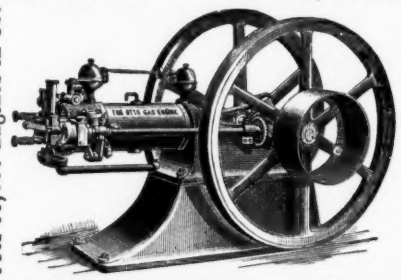
"OTTO" GAS ENGINE WORKS.

SCHLEICHER, SCHUMM & CO.,

33d and Walnut Sts., PHILADELPHIA.

Branch Office, 151 Monroe St., CHICAGO. New York Agency, 18 Vesey St., N. Y.

Over 35,000 Engines in Use



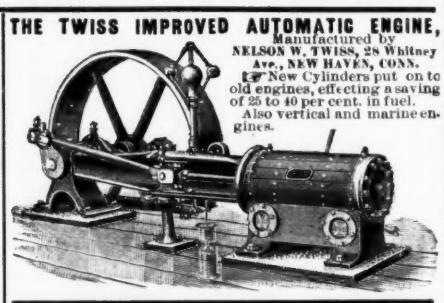
Guaranteed to consume 25 to 75 per cent. less Gas than any other Gas Engine doing the same work.

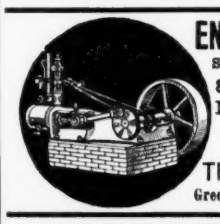
THE TWISS IMPROVED AUTOMATIC ENGINE,

Manufactured by NELSON W. TWISS, 28 Whitney Ave., NEW HAVEN, CONN.

☞ New Cylinders put on to old engines, effecting a saving of 25 to 40 per cent. in fuel.

Also vertical and marine engines.





ENGINES & BOILERS

Stationary & Semi-Portable.

8 to 25 HORSE-POWER.

High in Grade.

Low in Price.

Send for Pamphlet.

The W. C. LEFFEL CO.

Greenmount Ave., Springfield, O.

MACHINERY

For Reducing and Pointing Wire.

ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.

For Machines or Information address the Manufacturer,

S. W. GOODYEAR, Waterbury, Ct.

STRONG, WELL BUILT SERVICEABLE **STEAM ENGINES**

12 to 100 Horse Power

Every Engine tested under full load.

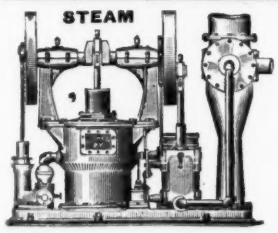
Adapted to Heavy, Continuous Work.

SUITABLE

Tubular & Firebox BOILERS on hand for immediate delivery.

CHANDLER & TAYLOR CO. INDIANAPOLIS, IND.

STEAM



CONOVER CONDENSERS.

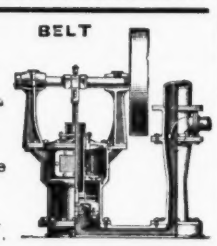
BELT AND STEAM DRIVEN.

Compound Condensing Corliss Engine on Independent Condenser.

HANDSOME CATALOGUE FREE.

THE CONOVER MFG. CO., 95 Liberty St., N.Y.

BELT



IF YOU WISH TO OBTAIN

Dry Steam

Write Postal for copy of our New Book, "How to Obtain Dry Steam." Mailed free.

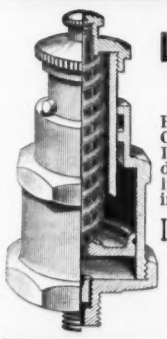
THE POND ENGINEERING CO.

Offices: ST. LOUIS, CHICAGO, KANSAS CITY.

CHARLES MURRAY

ENGRAVER ON WOOD

58 ANN ST. NEW YORK.



THE

LACKAWANNA GREASE CUP

Has a wide reputation as the CLEANEST, MOST EFFECTIVE and MOST ECONOMICAL device on the market for the lubrication of machinery bearings.

Liberal Discount to the Trade.

MANUFACTURED BY

Lackawanna Lubricating Co.,

SCRANTON, PA.

ENGINE CASTINGS

⅛, ¼, ½, 1 AND 2 HORSE POWER

High Speed, Upright, Horizontal, Marine.

ILLUSTRATED BOOKLET FREE.

A. L. WEED & CO., 106-108 Liberty St., N. Y.

PATENT OILERS, CYLINDER SIGHT FEED CUPS.

Government Regulation

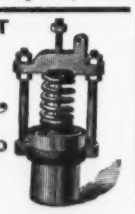
POP SAFETY VALVES,

For Stationary, Marine and Locomotive Boilers.

J. E. LONERGAN & CO., BRASS FOUNDERS AND FINISHERS,

211 Race Street, Philadelphia, Pa.

CATALOGUE FREE ON APPLICATION.

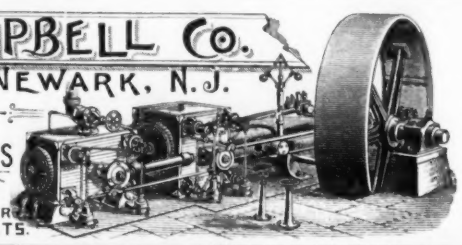


THE WATTS, CAMPBELL CO.

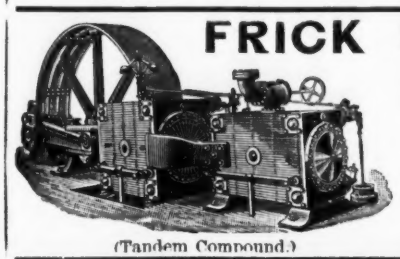
MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

NEWARK, N. J.

CONTRACTS TAKEN FOR COMPLETE POWER PLANTS.



FRICK COMPANY, WAYNESBORO, PA.



(Tandem Compound.)

ECLIPSE CORLISS ENGINES,

40 TO 2,000 H. P., ALL STYLES.

Send for Illustrated Catalogue.

ALSO BUILDERS OF

Electric High Speed Engines and Ice-Making and Refrigerating Machinery.

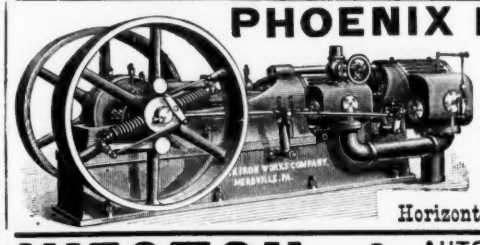
PHOENIX IRON WORKS CO.

MEADVILLE, PA.

New York, 15 Cortlandt St

Chicago, 418 Chamber of Commerce.

Sole Manufacturers of the



"Dick & Church" Automatic Cut-off Engine

Single, Tandem Compound, and Triple Expansion.

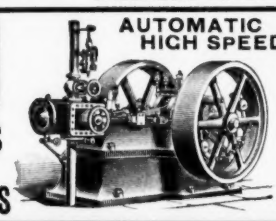
Horizontal Tubular and Manning Vertical Boilers.

WESTON

HIGH PRESSURE BOILERS

AND

COMPLETE POWER PLANTS



AUTOMATIC HIGH SPEED **ENGINE**

WESTON ENGINE CO.,

PAINTED POST, N. Y.

REPRESENTATIVES.

JULIAN SCHOLL & CO., 126 Liberty St., N. Y.
GEO. D. HOFFMAN, 83 Lake St., Chicago.
H. M. SCIPLE & CO., 3d & Arch Sts., Phila., Pa.

HIGH GRADE AUTOMATIC CUT-OFF ENGINES.

SIMPLE, TANDEM AND CROSS **COMPOUNDS**

No other engine has a perfectly balanced valve.

OUR GUARANTEE. WHO DARE MEET IT?

The engine shall not run one revolution slower when fully loaded than when running empty, and a reduction of boiler pressure from the greatest to that necessary to do the work, will not reduce the speed of engine one revolution. Any engine failing to meet this guarantee becomes the property of the purchaser upon payment of one dollar. Send for Catalogue.

Branch Offices. 141 Liberty St. New York, N.Y. 412 Washington Ave. St. Louis, Mo.

J. H. McEWEN MFG. CO. RIDGWAY, PA.

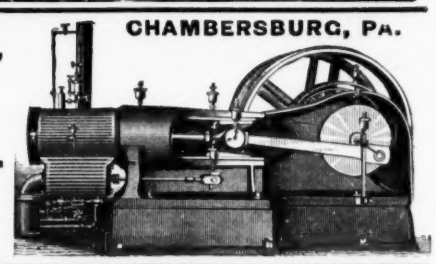
TAYLOR ENGINE COMPANY, CHAMBERSBURG, PA.

SINGLE AND COMPOUND

AUTOMATIC ENGINES.

BRANCH OFFICES:

165 Washington St., N. Y.
46 N. 7th St., Philadelphia.
77 Haverhill St., Boston.
28 W. Randolph St., Chicago.
99 1st Ave., Pittsburgh
179 Race St., Cincinnati.



CORLISS ENGINES.

HIGHEST ECONOMY. TANDEM OR TWIN COMPOUND.

CLOSEST REGULATION. CONDENSING OR NON-CONDENSING.

50 H. P. to 2,000 H. P.

Catalogue Ready. M. C. BULLOCK MFG. CO.,

26 W. Washington St., Chicago.

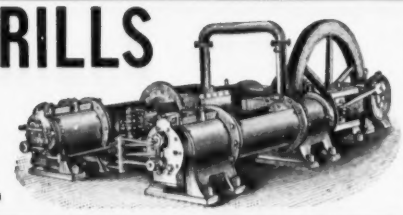
LINK-BELT ENGINEERING CO.

NICETOWN PHILA.

49 DEY ST. NEW YORK.

Elevators, Conveyors, Manila Rope Power Transmission Machinery, Ewart Detachable Link Belting, Dodge Chain, Howe Chain, etc. Western Connection, Link-Belt Machinery Co., Chicago, Ill.

ROCK DRILLS AND AIR COMPRESSORS.



AIR COMPRESSORS WITH COMPOUND AIR CYLINDERS, AND COMPOUND STEAM CYLINDERS WITH MEYER OR CORLISS VALVES.

RAND DRILL CO.,

23 Park Place,

NEW YORK, U. S. A.

BRANCH OFFICES: Monadnock Building, Chicago; Ishpeming, Mich.; 1316 18th St. Denver; Sherbrooke, P. Q., Canada; Apartado 830, Mexico City.

PATTERNS

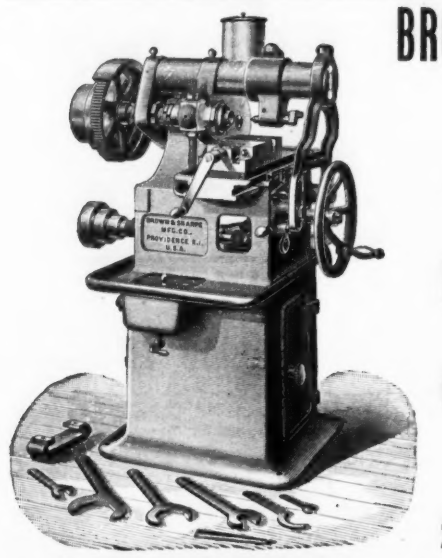
OF ALL KINDS TO ORDER.

CONTRACTS SOLICITED.

CINCINNATI PATTERN WORKS,

W. L. MERSFELDER, PROP.

CINCINNATI, OHIO.



No. 2 PLAIN MILLING MACHINE.

BROWN & SHARPE MFG. CO.,
PROVIDENCE, R. I.

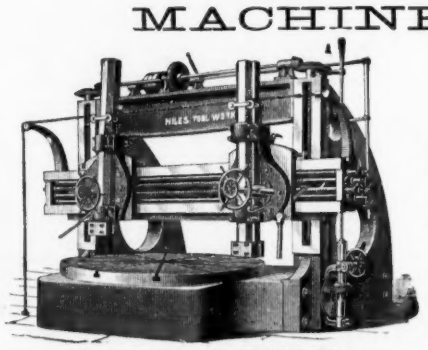
ARBORS AND COLLETS

FOR USE ON

MILLING,
GRINDING, AND
GEAR CUTTING MACHINES

MACHINE TOOLS
ON EXHIBITION AT
23 South Canal Street, CHICAGO, ILL.
S. A. SMITH, Western Representative.

NILES TOOL WORKS,
HAMILTON, OHIO.
MACHINE TOOLS.



12-FOOT BORING AND TURNING MILL.

BORING AND TURNING MILLS
A SPECIALTY.

Built in sizes to swing from 37 inches diameter to 30 feet diameter. Housings are double-webbed. Table runs on heavy spindle supported by a truncated cone extending down from bed, making machine self-contained. Boring Bars counterbalanced at all angles. Feeds automatic at all angles.

Correspondence solicited.

NEW YORK, 136 & 138 LIBERTY ST. CHICAGO, PHENIX BLDG. PITTSBURGH, LEWIS BLOCK.

INCREASED SALES

Show that our customers appreciate the value of improvements made in

JENKINS PACKING.

It can be used again and again. Does not **ROT** or **BURN** out. Have you tried it recently? If not, DO SO! Look for "Trade Mark."

JENKINS BROS., New York Philadelphia, Boston and Chicago.

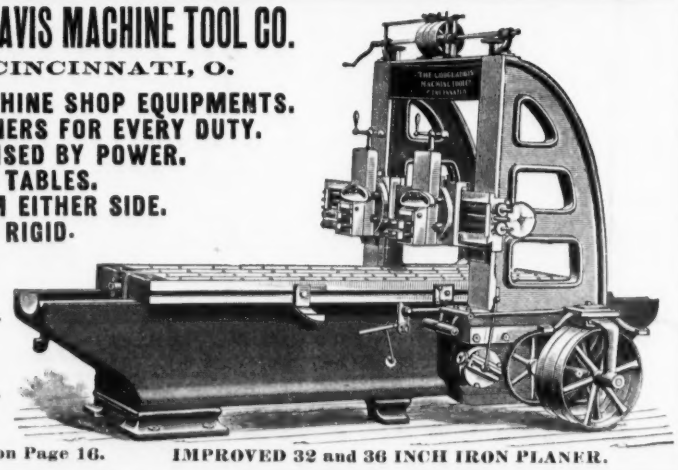
CRANES THE YALE & TOWNE MFG. CO. STAMFORD CONN NEW YORK CHICAGO PHILA BOSTON

THE LODGE & DAVIS MACHINE TOOL CO.
Works, CINCINNATI, O.

COMPLETE MACHINE SHOP EQUIPMENTS.
IMPROVED PLANERS FOR EVERY DUTY.
CROSS RAIL RAISED BY POWER.
DEEP BEDS AND TABLES.
OPERATED FROM EITHER SIDE.
POWERFUL AND RIGID.

NEW YORK HOUSE, 64 Cortlandt St.
CHICAGO HOUSE, 68 and 70 So. Canal St.
CLEVELAND HOUSE, 32 So. Water St.
PITTSBURGH HOUSE, Market and Water Sts.
COVENTRY, ENGLAND, Alfred Herbert.

See Advertisement on Page 16.



IMPROVED 32 and 36 INCH IRON PLANER.

EBERHARDT'S ENTIRELY AUTOMATIC GEAR AND RACK CUTTERS,

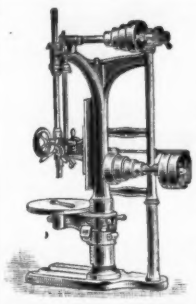
CUTS
GEARS AND RACKS
LIKE THIS.

MOTOR GEARS AND ALL LARGE WORK.

ALL the LARGE PLANTS are using our machines.

BEFORE DECIDING CONSULT

GOULD & EBERHARDT,
N. J. R. R. AVE.,
Green & Bruen Sts., Newark, N. J.



THE PRATT & WHITNEY CO.,
Hartford, Conn.,
MANUFACTURE

Renshaw's Ratchet Drills, Nos. 1 and 3; **Upright Self-Feeding Hand Drilling Machines** for Blacksmiths; **Upright Drilling Machines,** single and multi-spindle, both those in which the spindles are without feed movement and tables are operated by hand or foot lever, and those in which the tables have provision for adjustment, and spindles are fed by hand lever, or by hand wheel, or automatically; also, **Horizontal Drilling Machines,** single and multi-spindle.

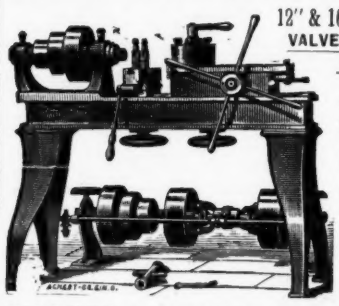
WESTERN BRANCH, 100 West Washington St., Chicago, Ill.

THE BILLINGS & SPENCER COMPANY
HARTFORD, CONN.
MANUFACTURERS OF

Machinists' Tools *Pliers*
Hammers *Wrenches*
Ratchet Drills *Taps*
Eye Bolts *Carbon Tongs*
Gauges *Hand Vises*

QUALITY THE BEST
DROP FORGINGS OF ALL DESCRIPTIONS

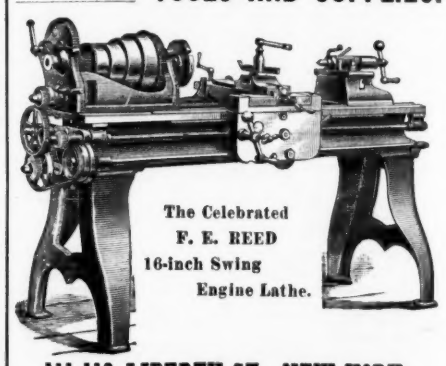
BRASS WORKING MACHINERY



12" & 16" MONITORS. VALVE MILLING MACHINES.
Double Key Lathes, Speed Lathes, Slide Rests. Revolving Chucks for Globe Valves, Two-Jawed Chucks, Small Tools and Fixtures.

WARNER & SWASEY, Cleveland, O.

MANNING, MAXWELL & MOORE,
Manufacturers and Dealers in all kinds of
RAILWAY and MACHINISTS' **TOOLS AND SUPPLIES.**

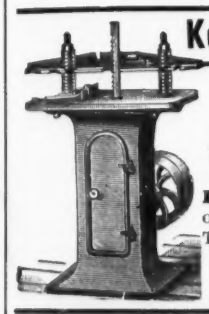


The Celebrated F. E. REED 16-inch Swing Engine Lathe.

111-113 LIBERTY ST., NEW YORK.

We carry the largest line of Tools and Supplies in the City.

GEO. W. FIFIELD,
MANUFACTURER OF
ENGINE LATHES
FROM 17 to 50 IN. SWING.
Cuts, Photographs and Prices furnished on application.
Lowell, Mass., U. S. A.



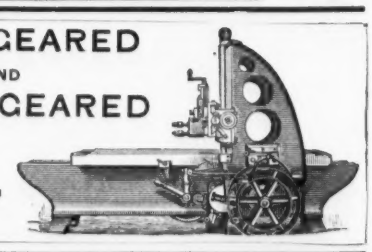
Key-Seating Machines and 20 in. Drills
A SPECIALTY.
SEND FOR LIST OF
New and Second-Hand
Lathes, Planers, Drills,
or anything in Machinists' Tools or Supplies.
W. P. DAVIS,
Rochester, N. Y.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

J. M. ALLEN, PRESIDENT.
WM. B. FRANKLIN, VICE-PRESIDENT.
F. B. ALLEN, SECOND VICE-PRESIDENT.
J. B. PIERCE, SECRETARY & TREASURER

The new edition of my Treatise on Teeth of Gears is sold at a reduced price. One dollar in cloth, and sixty cents in paper cover. Postpaid. Send stamps.
GEORGE B. GRANT, Lexington, Mass.

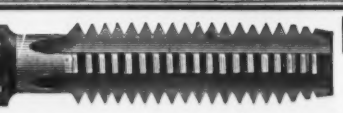
PLANERS SPUR GEARED AND SPIRAL GEARED
MANUFACTURED BY
The G. A. GRAY CO.,
479 Sycamore St., CINCINNATI, O.



THE HENDEY MACHINE CO. TORRINGTON, CONN.
MANUFACTURERS OF **MACHINE TOOLS.** SEND FOR OUR CATALOGUE.

CHAS. CHURCHILL & CO., Agts. 21 CROSS ST., Finsbury, London, Eng.

J. M. CARPENTER PAWTUCKET, R. I.



Manufacturer —of— TAPS & DIES